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ABSTRACT

This book presents the methods and findings of a critical review of the "Dictionary of Occupational Titles" (DOT) published by the United States Department of Labor. Following an introduction to the scope of the study in the first chapter, the book describes the study and its results in eight following chapters. Chapter 2 contains a detailed description of the current edition of the DOT to suggest to readers the nature of the document. Chapters 3 and 4 describe the ways that the DOT and associated materials are used inside and outside the Department of Labor Employment Service. Chapters 5 and 6 describe how the DOT is produced: Chapter 5 focuses on the organization of the occupational analysis program of the Employment Service, the unit charged with producing the DOT, and Chapter 6 describes the process by which the current edition was created. Chapters 7 and 8 evaluate the DOT: Chapter 7 focuses on the adequacy of the data it contains, and Chapter 8 discusses the DOT and other classification systems as tools for assessing the similarity of occupations. Chapter 9 presents the committee's conclusions and recommendations. In addition to the nine chapters of the report, eight appendixes provide data or detailed analysis of specific topics. (KC)

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WORK, JOBS, AND OCCUPATIONS:

A Critical Review of the *Dictionary of Occupational Titles*

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WORK, JOBS, AND OCCUPATIONS:

A Critical Review of the *Dictionary of Occupational Titles*

ANN R. MILLER
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and Analysis
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Preface

The division of labor—the deployment of human resources in the production of goods and services for society—has engaged the attention of social observers throughout recorded history. For most of this time a limited number of terms for describing traditional activities were sufficient to convey to all the nature of the work performed. But the increased complexity of the division of labor that accompanied what is commonly known as the industrial revolution altered the situation; and the proliferation of services that has become the mark of postindustrial society has continued to exacerbate the difficulty of comprehending the nature of the tasks included in a given occupational title. Moreover, the continuous impact of technological innovation has meant that the work content of a specific occupation may change dramatically although its title remains unaltered. Many years ago the compilers of the pioneer *A Dictionary of Occupational Terms* (Great Britain Ministry of Labour, 1927) observed that "[m]any industries are passing through a period of transition, so that the same occupational term may still be applied, for example, to handicraft workers, carrying through an entire series of manual operations, and to factory hands tending a machine and working under conditions of high specialisation." Their example may be less pertinent now than it was in the Britain of the 1920s, but the problem they refer to remains as critical as it was then.

More than 100 years ago the U.S. Bureau of the Census began grouping occupational titles, which had previously been merely listed, in its publications in order to clarify the nature of the work performed.

Throughout this century the Census Bureau has published, as an integral part of each census, a classified index of occupational titles included in each of its published occupational units and has continued to group the units into broad occupational categories. But the Census Bureau has never attempted to provide descriptions of its categories or of its units.

As chapter 1 notes, when the U.S. Employment Service was first established, it too relied on occupational titles for matching job seekers with jobs, but it was quickly apparent that the lack of standardized descriptions hindered the accomplishment of this task, and the compilation of the first American *Dictionary of Occupational Titles* began almost immediately. For the matching of workers and jobs in a system involving thousands of titles, however, it is clearly not enough merely to describe activities; it is also necessary to arrange the units defined in an order helpful in illuminating the relationship of the nature of the work in one unit to that in others. The resulting arrangement is, then, a classification system, organized according to certain principles, assumed or demonstrated, about key elements in the nature of work.

These two components—the definition of units and their classification—compose a standard approach to the understanding of observed phenomena, a method by which large quantities of information have traditionally been reduced to manageable proportions. Recently, however, the development of the computer has introduced new ways of processing information and has raised questions about the continuing usefulness of the standard approach, at least for purposes of job placement.

In 1977 the U.S. Employment Service published a new edition of the *Dictionary of Occupational Titles* (DOT), the latest in a series going back some 40 years. In planning the allocation of its resources for the 1980s, officials of the U.S. Employment Service decided that the publication of the new edition provided an appropriate occasion for evaluating the program underlying the DOT. Specifically, they requested the National Academy of Sciences to review whether "computerization" obviated the need for such a document in the operations of the Employment Service; whether there was a wider need for the information provided; and whether, if the program and its products were continued, the current procedures and assumptions were adequate or required substantial revision. The Committee on Occupational Classification and Analysis was established by the National Research Council's Assembly of Behavioral and Social Sciences to respond to this request. This report presents the results of the committee's investigation and the recommendations that arose from our deliberations.

The committee was very fortunate in being able to persuade Donald J. Treiman to take leave from the University of California, Los Angeles, in order to be our study director. He supervised and coordinated the project, made major substantive contributions to the analytic design of the study, and contributed significantly to the writing throughout the report.

Treiman assembled a very competent staff, to all of whom we are indebted. The committee was simultaneously conducting a study for the Equal Employment Opportunity Commission, so there was some division of labor between the two tasks, but all staff members participated actively in the discussions and reviews of successive drafts of the report. Pamela S. Cain had primary responsibility for assembling the material on the procedures used in creating the DOT and the evaluation of these procedures. Patricia A. Roos was responsible for conducting the user surveys and analyzing the results, for describing the use of the DOT within the Employment Service (a task to which Charles Turner also contributed), and for preparing the materials on the use of the DOT by other government agencies (a task to which Monica K. Sinding also contributed). Charles F. Turner prepared preliminary analyses of data on labor mobility, which served as the basis for discussion of the DOT classification system. Heidi I. Hartmann contributed to the writing and revision efforts at many points in the report, particularly the sections on classification and on the organization of the occupational analysis program. June Price prepared materials on the research uses of the DOT.

The committee's thanks also go to Eugenia Grohman for her advice and to Christine L. McShane for her excellent editing of the final draft. Our administrative secretary, Rose S. Kaufman, with the help of Benita Anderson, performed crucial services in preparing the manuscripts and in arranging our meetings with efficiency and dispatch.

All members of the committee reviewed the numerous drafts of the report. Gary D. Gottfredson and John A. Hartigan were particularly helpful in their contributions to the material on classification. Ernest J. McCormick's long experience with the issues involved in job analysis and job placement was invaluable to our discussions.

ANN R. MILLER, *Chair*
Committee on Occupational
Classification and Analysis

1 Introduction and Summary

INTRODUCTION

During the depression of the 1930s, Congress established a national employment service to assist workers in finding suitable employment and employers in finding employees (Wagner-Peyser Act of 1933). Although the program of the U.S. Employment Service has undergone significant changes since the 1930s, its basic aims have not been altered.

A program of occupational research was also initiated "to furnish public employment offices . . . with information and techniques [to] facilitate proper classification and placement of work seekers" (U.S. Department of Labor, 1939:xi). Throughout the 1930s this occupational research program was conducted under the supervision of a technical board, the majority of whose members were nominated by the Social Science Research Council and the National Research Council of the National Academy of Sciences. In 1939 this research program produced the first edition of the *Dictionary of Occupational Titles.*

Subsequent editions of the *Dictionary of Occupational Titles* were produced in 1949, 1965, and 1977. While they vary somewhat in their coverage of the economy (the first edition being least comprehensive) and in the details of their structure, each edition was designed to be an operational tool for use in the day-to-day functioning of Employment Service offices. Each edition was intended to provide a catalogue of the occupational titles used in the U.S. economy as well as reliable descriptions of the type of work performed in each occupation. In the early years, officials of the Employment Service believed a dictionary was of great practical importance because "getting qualified workers into appropriate jobs is a task that can be most adequately performed when the transition is based upon a thorough knowledge of both worker and job" (U.S. Department of Labor, 1939:xi).

Prior to the publication of the first edition of the *Dictionary of Occupational Titles*, each local office of the national Employment Service developed its own information about occupations and gave its own individual meanings to the job titles used in operating the Employment Service's placement system (U.S. Department of Labor, 1965a:ix). There was as a result no uniform language for the exchange of occupational information among Employment Service staff within local offices, between offices in a particular locale, or between the various local offices and the national office of the Employment Service. Work on the *Dictionary of Occupational Titles* was begun to remedy this situation. Subsequent revisions were undertaken to reflect changes in the occupational composition of the work force (e.g., the addition of new occupations reflecting changes in the technologies of production), to improve the accessibility of information contained in it, and to facilitate job matching.

CHARGE TO THE COMMITTEE

Throughout the last 4 decades the occupational titles contained in the various editions of the *Dictionary of Occupational Titles* have served as the Employment Service's basic tool for matching workers and jobs. The *Dictionary of Occupational Titles* has also played an important role in establishing skill and training requirements and developing Employment Service testing batteries for specific occupations. Recently, however, the role of the *Dictionary of Occupational Titles* has been called into question as a result of planned changes in the operation of the Employment Service.

A plan to automate the operations of Employment Service offices using a descriptive system of occupational keywords rather than occupational titles has led to a claim that a dictionary of occupational titles and the occupational research program that produces it are outmoded. Since the automated keyword system does not rely explicitly on defined occupational titles, it is claimed that the new system would reduce costs by eliminating the need for a research program to supply the occupational definitions. In fiscal 1977 the program cost almost $3 million.

In light of these considerations the committee was asked to evaluate the future need for the *Dictionary of Occupational Titles*. Neither the committee nor the Department of Labor confined the question exclusively to needs within the Employment Service—although the needs of the

Employment Service were a primary consideration. It was recognized that the use of such a dictionary by a wide range of government and private organizations and individuals might justify its continued production even if it were no longer a major operating tool of the Employment Service. In such a case, however, responsibility for the *Dictionary of Occupational Titles* and its occupational research program might be reasonably transferred to an agency other than the Employment Service.

The committee was charged first with deciding whether there is a continuing need for the *Dictionary of Occupational Titles.* The committee sought to answer this question by (1) surveying purchasers of the *Dictionary of Occupational Titles,* (2) interviewing major federal users of the *Dictionary of Occupational Titles,* (3) surveying selected state users, (4) compiling a bibliography of its use in social science research, (5) interviewing national and state Employment Service staff, and (6) visiting local Employment Service offices. On the basis of information gathered from these sources (see chapters 3 and 4) the committee concluded that there is an important and continuing need for a comprehensive, reliable catalogue of occupations in the U.S. economy as well as descriptions of the work performed in each occupation.

The committee was next charged to consider a set of questions concerning the adequacy and usefulness of the current edition of the *Dictionary of Occupational Titles* and the types of research that would be needed to produce a more reliable and useful document. The committee's concerns in this regard centered on the reliability and validity of the occupational data collected and analyzed by the occupational analysis program of the Employment Service, the usefulness of the classification structure of the current edition, and the potential for improvement in the document through revisions in the kinds of data collected and data collection procedures. The general conclusion of the committee is that the *Dictionary of Occupational Titles* requires improvement in a number of respects to render it fully adequate to meet both the current needs of the Employment Service and the needs of other users.

The committee was also charged to consider organizational changes required to produce a more adequate *Dictionary of Occupational Titles.* In considering this question the committee benefited from a short-term management study conducted during the first stage of its work by an independent contractor to the Employment Service (Booz, Allen & Hamilton, Inc., 1979). This study describes the problems inherent in the organizational structure of the program and informed the committee concerning changes in staffing and resources that might be required to produce a more useful and reliable *Dictionary of Occupational Titles.* In the committee's judgment the major organizational change required to improve the *Dictionary of Occupational Titles* is the establishment of a permanent, professional research unit to develop and carry out an ongoing program of occupational research in several areas identified by the committee.

Finally, the committee has undertaken—to the extent possible given constraints of time and resources—a conceptual review of the Employment Service's automated matching program.

ORGANIZATION OF THE REPORT

Chapter 2 contains a detailed description of the current edition of the *Dictionary of Occupational Titles* to suggest to readers the nature of the document that is the main focus of the report. Chapters 3 and 4 describe the ways that the *Dictionary of Occupational Titles* and associated materials are used inside and outside the Employment Service. Chapters 5 and 6 describe how the *Dictionary of Occupational Titles* is produced: chapter 5 focuses on the organization of the occupational analysis program of the Employment Service, the unit charged with producing the *Dictionary of Occupational Titles*, and chapter 6 describes the process by which the current edition was created. Chapters 7 and 8 evaluate the *Dictionary of Occupational Titles*: chapter 7 focuses on the adequacy of the data it contains, and chapter 8 discusses the *Dictionary of Occupational Titles* and other classification systems as tools for assessing the similarity of occupations. Chapter 9 presents the committee's conclusions and recommendations. In addition to the nine chapters of the report there are eight appendixes providing data or detailed analysis of specific topics.

SUMMARY

CONTENT AND STRUCTURE OF THE DOT

Chapter 2 provides a description of the content and structure of the current—fourth edition—*Dictionary of Occupational Titles* (DOT). The DOT contains information on 12,099 occupations and an additional 16,702 related or synonymous occupational titles. Each occupation is identified by a nine-digit code and is defined on the basis of the tasks performed. The nine-digit code represents a classification structure based on the type of work performed (the first three digits) and the complexity of work in relation to data, people, and things (the second three digits); the final three digits are a unique numerical identification for each occupation. The chapter also describes briefly a set of 41 occupational characteristics,[1] known as worker traits, on which information is available for each occupation (on computer tape and in to-be-published supplements to the DOT). In the course of developing the occupational description for the DOT, analysts rate each occupation for these worker traits, which include the aptitudes, temperaments, and interests necessary for adequate performance; the training time necessary to prepare for an occupation; the physical demands of the occupation; and the working conditions under which the occupation typically occurs. In sum, the DOT is simultaneously a dictionary providing definitions of occupations, a classification system, and a source of data on occupational characteristics.

USE OF THE DOT BY THE EMPLOYMENT SERVICE

Chapter 3 describes the major ways in which the DOT is used within the Employment Service. First, the DOT provides a classification structure for organizing information about job openings in self-search job banks located in local Employment Service offices. Second, the dictionary aspect and, to a more limited extent, the classification structure are used by placement interviewers and employment counselors in Employment Service offices as aids in matching job applicants with job openings. Data on occupational characteristics (the worker traits and worker functions) are used only occasionally in the job placement process, mainly by employment counselors as aids in exploring vocational options.

In addition to its direct use as a placement and counseling tool the DOT serves as a data source for the preparation of a series of career brochures, and the classification structure serves to organize the data for the monthly publication of labor market information by the national office for use in local Employment Service offices.

Finally, the DOT is used by the Division of Testing and the Division of Labor Certification, two subunits of the Employment Service. The Division of Testing develops tests with a specific orientation toward the aptitudes, skills, etc. that are relevant to the worker traits identified in the DOT supplements; these tests are used in local Employment Service offices for counseling purposes. The Division of Labor Certification uses the DOT to identify specific occupations for which the demand for workers exceeds the available supply of qualified American workers—which is the legal requirement for the certification of foreign workers.

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[1] Data are collected on 46 variables, three worker functions (DATA, PEOPLE, and THINGS) and 43 worker traits. However, three of the worker traits, representing aspects of general educational development (GED), are usually combined into a summary measure of GED. Hence in many published lists, only 41 worker traits are shown.

In sum, extensive use is made of the DOT within the Employment Service.

USE OF THE DOT OUTSIDE THE EMPLOYMENT SERVICE

Chapter 4 describes major uses of the DOT outside the Employment Service. Indication of the extent of such use is provided by the fact that 148,145 copies of the third edition DOT were sold in the course of its 13-year life (1965–1977) and more than 115,000 copies of the fourth edition were sold in the first 21 months following publication in December 1977 (not including 30,000 copies distributed within the Employment Service). To determine the extent and nature of the use of the DOT, committee staff conducted three studies: a questionnaire survey of a probability sample of purchasers of the fourth edition DOT; site visits to federal agencies identified as major users, supplemented by a questionnaire survey of DOT users in state agencies; and a literature review of social science research uses of the DOT.

The survey of DOT purchasers revealed that a wide variety of organizations use the DOT in their work, including educational institutions, government agencies, private for-profit companies, and nonprofit agencies. These organizations use the DOT for a variety of purposes, the most prominent being career and vocational counseling, library reference, rehabilitation counseling, personnel management, and employment placement. The dictionary aspect is most widely used, but a majority of purchasers use the classification as well; other parts of the DOT are less widely used. Most purchasers (88 percent) report that discontinuing the DOT would disrupt their work, and about a third (36 percent) report that the disruption would be serious.

Site visits to a number of federal agencies revealed heavy reliance on the DOT, as did responses from the special state agency user sample. The Bureau of Apprenticeship and Training of the Department of Labor, for example, uses the DOT's measure of training time requirements for occupations (specific vocational preparation) as a standard against which to certify apprenticeship programs for skilled trades; the bureau also uses the DOT classification for record-keeping purposes. The Bureau of Labor Statistics of the Department of Labor relies on the DOT as a framework for collecting, organizing, and reporting various types of labor market information. The Bureau of Disability Insurance of the Social Security Administration makes extensive use of the DOT, especially the worker trait and worker function data, for the purpose of disability determinations and judgments as to what other jobs a disabled person might be able to perform. The Veterans Administration makes similar use of the DOT materials as an aid in rehabilitation and vocational counseling, as do vocational rehabilitation programs in a number of states. Finally, occupational information from the DOT is used by vocational educators in a number of federal and state agencies for the purpose of program planning, curriculum development, and counseling.

The DOT has increasingly gained the attention of social researchers. More than 150 research articles have been published since 1965 that either use data from the DOT or provide evaluations of the quality of the DOT; an annotated bibliography of these publications appears in Appendix C. The DOT code is frequently used to describe the socioeconomic distribution of subject samples (in psychological studies) and to match experimental groups with control groups with respect to occupational category and skill level. The worker traits and worker functions have been used in many capacities, most notably in describing the distribution of job characteristics across various sectors of the labor market and in examining shifts in labor force composition. Economists often turn to the worker trait and worker function scales when studying the determinants of wage structure, and psychologists use this information in studying the relationship between occupational characteristics and psychological functioning as well as effects on performance. In addition, the DOT has been a valuable resource in the more applied areas of vocational psychology and counseling. Finally, a number of new scales, inventories, and classification systems have incorporated DOT data and scales.

The DOT has served as a model or provided basic data for a number of other important occupational classifications, most notably the new *Standard Occupational Classification* (U.S. Department of Commerce, 1977), developed by the Office of Federal Statistical Policy and Standards to promote the standardization of federal occupational statistics, and the *International Standard Classification of Occupations* (International Labour Office, 1958, 1968).

Although the DOT and its associated materials have been widely used by many individuals and organizations outside the Employment Service, other products of the occupational analysis program have not had a similarly wide impact; as far as we can ascertain, their use is restricted almost entirely to the Employment Service.

THE OCCUPATIONAL ANALYSIS PROGRAM

Chapter 5 describes the organization of the occupational analysis program of the U.S. Employment Service. The DOT is produced by the Division of

Occupational Analysis in Washington, D.C., working in conjunction with 11 field centers located around the country. Job analysts working in the field centers collect the bulk of the data on which the DOT is based by visiting business establishments, observing workers in jobs, and recording and scaling the information observed. Currently, there are 129 positions in the field centers and 15 in the national office; of those 15, only 10.5 are in the Occupational Analysis Branch (the others are in the Job Search Branch).

The national office is charged with directing the technical aspects of the work of the 11 field centers, including planning new editions of the DOT and other publications, designing data collection procedures and research efforts, and coordinating the activities of the field centers. The field centers are, however, administratively responsible to the employment agencies of the states in which they are located and are subject to state regulations. This arrangement creates substantial confusion and tension regarding lines of authority. In addition, the national office has had administrative difficulties for several years, experiencing a rapid turnover of leadership and a severe reduction of staff. As a result the national office has not provided effective leadership to the field centers—leadership that is crucial to the success of an extremely complex data collection task.

About 80 percent of field center staff time is devoted to work related to the production of the DOT. The remainder is spent on the preparation of career guides and brochures; providing training and technical assistance to government agencies and other organizations on the products, methods, and techniques of occupational analysis; and carrying out special projects at the request of host state Employment Service agencies.

PRODUCTION OF THE FOURTH EDITION DOT

Chapter 6 describes the procedures used to produce the fourth edition DOT. The information included in the DOT is based on on-site observation of jobs as they are performed in diverse business establishments and, for jobs that are difficult to observe, on information obtained from professional and trade associations. More than 75,000 on-site job analyses were conducted in preparation for the fourth edition DOT.

The sampling of jobs for observation was a complicated and somewhat indirect process: First, the national office assigned to each field center responsibility for coverage of particular industries; these industries were sometimes very broadly specified (e.g., retail trade) and sometimes very narrowly specified (e.g., button manufacturing). Second, establishments within each industry were chosen for analysis, with some effort being made to choose "typical" establishments; the final selection, however, was dependent on the willingness of establishments to cooperate. Third, some or all jobs within an establishment were chosen for observation in negotiation with the management of the establishment.

In conducting job analyses within an establishment the analyst prepared a description of major work processes, a table of organization, and a staffing schedule showing the distribution of jobs within the establishment. Using these materials, analysts selected individual jobs for analysis; jobs that were similar to an occupation described in the third edition DOT were less likely to be analyzed. The selected jobs were observed, and/or incumbents or supervisors were interviewed. For each analyzed job the analyst prepared a job analysis schedule, recording the tasks entailed in the job, the machines, tools, or work aids used, the working conditions, and a variety of other information. On this basis a description of the job was prepared, and the job was rated with respect to 46 characteristics (worker functions and worker traits). These procedures were modified somewhat as the fourth edition deadline approached to speed completion of the data collection phase.

Job analysis schedules produced from 1965 to 1976, intended for use in compiling the fourth edition, were filed in the North Carolina field center according to third edition codes. The actual writing of occupational definitions for the fourth edition did not begin until 1976, the year before the scheduled publication of the fourth edition. Definitions were prepared mainly on the basis of the material included in the job analysis schedules. Both the coverage of occupations and the quality of the descriptions proved to be very uneven. Some third edition occupations had no new documentation, while others had an excess—the record is 652 job analysis schedules for Materials Handler. Some schedules contained only the notation "same as third edition," and for some occupations no job analysis schedule was available but only a letter from a professional or trade association. Furthermore, procedures for deciding how to combine individual job descriptions into composite occupational definitions were very unclear.

ASSESSMENT OF THE OCCUPATIONAL INFORMATION IN THE DOT

Chapter 7 provides an evaluation of the quality of the DOT as a source of occupational information, with particular attention to the implications of the procedures described in chapter 6. Available data make it difficult to evaluate the representativeness of the coverage of jobs in the *Dictionary of Occupational Titles*. There are, however, indirect indications that the coverage has been disproportionately concentrated in the manufacturing industries and that certain other industries, such as trade and services, are substantially underrepresented.

A second observation about the source data used to derive the occupational descriptions in the DOT has to do with the number of job analysis schedules underlying each description. About 16 percent of the occupational descriptions included in the fourth edition DOT were prepared without the benefit of a single job analysis schedule, 29 percent were based on information from one job analysis schedule, and 19 percent were based on information from two schedules; thus nearly two thirds of the occupations described in the fourth edition DOT were based on the observation of fewer than three jobs. Although there may indeed be a number of occupations for which multiple on-site observations would be redundant and wasteful, in the absence of information regarding the heterogeneity or homogeneity of job content within occupations, the extent to which the occupational descriptions rest on such limited observations raises some question about their adequacy.

The conjunction of these two attributes of the data collection procedures—the nonrepresentative distribution of establishments visited and the fact that most of the occupational descriptions are based on two or fewer job analyses—may well be related to a third feature: the very uneven distribution of numbers of occupations identified within the major occupation categories. In relation to their share of the labor force, the number of specific occupations identified under the processing, machine trades, and benchwork categories is substantially greater, and the number in the clerical and sales and service categories is substantially smaller than would be expected (Table 7-3). There is, again, no reason to expect these two distributions to be identical. Nevertheless, if there is a tendency for each job analysis to produce an occupational description (as the number of job analyses per occupation suggests), the fact that fewer job analyses were performed for clerical workers, for example, may certainly be expected to have an effect on the number of specific clerical occupations identified.

Finally, with regard to the quality of source data, three fourths of the job analysis schedules used in compiling the fourth edition DOT do not meet the standards specified for a complete job analysis; the propensity to depart from standards increased during the period just prior to completion of the fourth edition DOT. At that time there was also a shift away from the preparation of new job analysis schedules toward the verification of existing schedules.

The remainder of chapter 7 is devoted to an evaluation of the worker function and worker trait ratings made in the course of job analyses and included in the collation of data available for each DOT occupation. These variables purport to measure the complexity of occupations, the training time required to prepare for them, the aptitudes, temperaments, and interests necessary for adequate job performance, the physical demands of occupations, and the working conditions under which they typically are performed. As a comprehensive source of occupational information these variables pose several difficulties. First, many are of dubious validity. Developed in the 1950s by piecing together available materials, these variables may not capture well important variability in the job content of today's economy. Second, the measurement of these variables is, on the whole, not highly reliable. A staff study of ratings by job analysts (reported in detail in Appendix E) found the reliability of ratings to be moderate on the average and very poor with respect to certain variables. Third, the 46 occupational characteristics appear to be highly redundant. A factor analysis of these variables conducted by the staff revealed that six factors account for 95 percent of the common variance—factors measuring substantive complexity, motor skills, physical demands, management activity, interpersonal skills, and undesirable working conditions.

On the basis of this analysis the committee has concluded that the worker traits and worker functions require thorough review, first at the conceptual level to determine what kind of occupational information is needed by the Employment Service and by other users and second at the technical level to determine how such information can best be generated.

One suspicion regarding these data can be discounted. Charges had been made that the worker function variables in the third edition DOT underrated occupations filled mainly by women. A comparison of scores on these variables for the third and fourth editions suggests that while the charges were substantially correct regarding the third edition, the fourth edition scores are apparently free of bias.

Despite deficiencies in the worker function and worker trait data for the fourth edition DOT, they remain the single most comprehensive set of occupational information available anywhere.

THE CLASSIFICATION OF OCCUPATIONS FOR JOB-WORKER MATCHING

Chapter 8 evaluates the classification structure of the DOT from the standpoint of its usefulness in matching job applicants with job openings and considers how it might be improved. If each job applicant knew precisely which occupations he or she was qualified for and willing to work at, no classification would be needed other than a list of job titles falling within each occupational category. However, this is not the case for most job applicants. Typically, a particular worker can do many jobs, and many workers do, in fact, hold many different kinds of jobs in the course of their work lives. Therefore for the Employment Service to serve job seekers best a mechanism should be available for matching each job applicant not only with jobs similar to those at which he or she has already worked or is specifically trained but with all jobs that the applicant could perform adequately. To do this requires that sets of "interchangeable" jobs be identified and that they be brought to the attention of the job seeker and of Employment Service placement staff.

Currently, most job placements by the Employment Service (about 75 percent in one center visited) are made via a self-search procedure in which job applicants peruse a list of job openings organized by DOT code. As a result "interchangeable" occupations tend to become limited to those with relatively similar codes as catalogued in successively finer detail by the first, second, third, etc. digits of the classification structure. However, a knowledgeable examination of the DOT makes it obvious that many occupations listed in different major (first digit) groups are interchangeable. Although the worker trait arrangement developed for the third edition DOT had as its rationale the illumination of cross-category linkages, it is clear from our review of Employment Service operations that it did not serve the purpose effectively; indeed, the worker trait arrangement was seldom used.

The committee has concluded that such linkages must be developed as part of the research activity of the occupational analysis program and incorporated into the placement operation on a systematic basis so that the information is available to an applicant using the microfiche listings in the job bank as well as to placement staff. To cite two simple examples, one cannot expect an applicant looking for a job as a ticket taker to know that openings are listed under 344.667-010 (Ticket Taker, Amusement and Recreation) and under 911.667-010 (Ticket Taker, Ferryboat) or one with experience as a radio dispatcher to know that both 379.362-010 (Dispatcher, Radio) and 919.162-010 (Dispatcher, Traffic or System) may include possible job openings.

There are, as noted, obvious cross-category linkages that are not revealed by the classification structure in the fourth edition DOT. Beyond these, however, there are undoubtedly many occupations whose similarity is less immediately obvious. The trained occupational analysts in the field centers and the national office are probably aware of many such linkages,[2] but no mechanism exists for incorporating such knowledge into the system, nor is any effort specifically directed at uncovering this interchangeability. The committee recommends that procedures for communicating information on cross-occupational linkages be established and that formal studies in this area be instituted. Such studies should exploit recent developments in the methodology of occupational analysis, such as task analysis and other forms of structured job analysis, and in the theory of vocational choice. These developments are reviewed in chapter 8; particular attention is devoted to two leading vocational theories that have developed classification schemes for matching workers and jobs: the Minnesota theory of work adjustment and Holland's theory of careers.

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[2] In fact, the New York field center has devised a set of such linkages for local use, although we were not able to ascertain the extent to which it was in operation.

In addition, the committee explored an alternative approach, the use of rates of naturally occurring mobility, to define clusters of interchangeable jobs. Although the fact that many workers actually do move from one occupation to another is not a necessary condition for assuming that those who can do one job can also do the other, it is a sufficient condition. The committee believes that an optimal approach to the identification of clusters of interchangeable occupations would be to combine analysis of the similarity of job content, especially with respect to skill requirements, with analysis of naturally occurring patterns of occupational mobility.

The committee recommends that consideration be given to the development of means of listing job openings that will group interchangeable occupations, whether defined by skill transferability or empirically on the basis of actually occurring mobility. This need not necessitate modifying the classification structure; alternatively, flexible listing formats could be explored, including multiple listings of jobs in the manner of cross-classifications in library card catalogues.

CONCLUSIONS AND RECOMMENDATIONS

Chapter 9 presents the conclusions and recommendations of the committee. On the basis of its analysis the committee concludes that there is a strong and continuing need both within and outside the U.S. Employment Service for the kind of information provided by the DOT but that substantial improvements in the procedures and products of the occupational analysis program are required in order to meet the national need for occupational information.

To effect this improvement, we make 3 general recommendations and 19 specific recommendations. The general recommendations are the following:

1. The occupational analysis program should concentrate its efforts on the fundamental activity of job analysis and on research and development strategies—for improving procedures, monitoring changes in job content, and identifying new occupations—that are associated with the production and continuous updating of the

Dictionary of Occupational Titles. The program should discontinue the publication of career guides.

2. A permanent, professional research unit of high quality should be established to conduct technical studies designed to improve the quality of the *Dictionary of Occupational Titles* as well as basic research designed to improve understanding of the organization of work in the United States.

3. An outside advisory committee to the occupational analysis program should be established. Its members should be appointed by the assistant secretary of labor for employment and training.

The specific recommendations are grouped into five general areas:

Data Collection Procedures

4. On-site observation of job performance by trained occupational analysts, including interviews with workers and supervisors, should continue as a major mode of data collection; experimentation with other data collection procedures, however, should also be undertaken.

5. Staffing schedules for establishments in which job analyses are performed should continue to be collected and should be used for research purposes. The recently discontinued tabulation by sex of the number of workers in each occupation should be reinstated.

6. The selection of establishments and work activities for which job analyses are performed should be made according to a general sampling plan designed for the particular requirements of occupational analysis.

7. Procedures should be designed to monitor changes in the job content of the economy. Both new occupations and changes in existing occupations should be identified.

8. The *Dictionary of Occupational Titles* should be expanded to include definitions of all occupations in the economy, whether or not they are serviced by the Employment Service.

Measurement of Occupational Characteristics

9. The worker trait and worker function scales should be reviewed and, where it is appropriate, replaced with carefully developed multiple-item scales that measure conceptually central aspects of occupational content.

10. A research activity of first priority should be review of the training time (GED and SVP), physical demand, and working condition scales.

Classification Issues

11. A major activity of the occupational analysis program should be investigation of cross-occupational linkages that indicate possible transferability of skills or experience.

12. The development of an automated procedure for matching job applicants with job openings should continue, but the current keyword system should not be accepted as optimal.

13. The classification system developed for the next edition of the DOT should be compatible with the standard system implemented by the Office of Federal Statistical Policy and Standards or its successor coordinating federal agency. That is, explicit procedures should be developed to enable the translation of occupational codes so that information can be organized and reported using a standardized classification.

Other Needed Research

14. Research priority should be given to developing criteria for defining "occupations"—the aggregation problem.

15. Basic research should be undertaken on the operation of labor markets to improve understanding of the processes by which workers acquire jobs.

Organizational and Administrative Issues

16. The leadership of the national office in the occupational analysis program should be strengthened, greater attention should be given to

coordination of field center activities, and the lines of federal authority should be clearly established.

17. The collection and dissemination of occupational information by the occupational analysis program should be a continuous process; activity should not fluctuate with the timing of new editions of the DOT.

18. Procedures followed in collecting data and developing the DOT should be carefully documented and publicly described.

19. The data produced for the DOT should be made publicly available.

20. A tabulation program should be instituted immediately to aggregate monthly data from Employment Service operations to the revised *Standard Occupational Classification* unit groups used in the 1980 Census of Population and subsequent Current Population Surveys.

21. A systematic program should be instituted to communicate additions and revisions of occupational definitions and their classification promptly to all operating staff in the Employment Service as well as to other interested persons.

22. The next edition of the DOT should not be issued until substantial improvements in the occupational analysis program have been made, following the recommendations made here.

SUPPLEMENTARY MATERIALS

The report contains eight appendixes that provide additional technical data or extended analysis of particular topics. Appendix A presents the questionnaire used in the probability survey of DOT purchasers (discussed in chapter 4) with response frequencies. Appendix B presents detailed reports of uses of the DOT by three major federal users, based on site visits to each of the agencies: the Bureau of Apprenticeship and Training of the Department of Labor, the Bureau of Disability Insurance of the Social Security Administration, and the Veterans Administration. Appendix C is an annotated bibliography of research uses of the DOT, with approximately 150 entries. Appendix D provides a bibliography of publications of the occupational analysis program, including publications of both the national office and the field centers. Appendix E is a study of the reliability of measurement of DOT worker functions and worker traits. Appendix F provides scores for selected worker function and worker trait variables for each of the categories of the 1970 Census detailed occupational classification; these are intended to be an aid to researchers. The two remaining appendixes serve as background to chapter 8: Appendix G assesses the Employment Service's keyword system, an automated system for matching job applicants with job openings, and appendix H discusses the use of occupational mobility data to evaluate and construct occupational classifications.

2 The Fourth Edition *Dictionary of Occupational Titles*: Structure and Content

The *Dictionary of Occupational Titles* (DOT) is a reference manual, intended mainly to assist Employment Service interviewers in placing workers in jobs. It also provides other users with a broad range of information on the content and characteristics of occupations. In this chapter the fourth edition DOT and closely related publications are described as an introduction to the discussion in chapters 3 and 4 about the use of the DOT inside and outside the Employment Service.

OCCUPATIONAL TITLES

The DOT is a dictionary, or compendium, of occupational titles in common usage in U.S. labor markets. The term "occupation," as used in the DOT, refers to the "collective description of individual jobs performed, with minor variations, in many establishments" (U.S. Department of Labor (1977b:xv); hereafter referred to as Fourth Edition DOT). Several types of occupational titles are distinguished. "Base titles" identify what the U.S. Department of Labor's occupational analysts consider to be distinct occupations; they are supposed to represent the job titles most frequently used by employers. Each base title is defined. "Master titles" (e.g.,

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Pamela S. Cain had primary responsibility for the preparation of this chapter.

apprentice, salesperson) refer to occupations found in a variety of work settings for which work content may vary but duties tend to be similar. Each master title is defined. "Term titles" (e.g., assembler, social worker) refer to titles common to a number of jobs that may differ with respect to the knowledge required, the tasks performed, or the job location. Each term title is defined. For two other types of titles, definitions are not provided: "alternate titles," which are synonyms of base titles, and "undefined related titles," which are specialized offshoots of particular base titles. The fourth edition DOT contains 28,801 titles, of which 12,099 (42 percent) are base titles. The definition and the frequency of each type of title are presented in Table 2-1.

THE DOT CODE

In the fourth edition DOT, titles are presented in order of their DOT codes. The classification scheme embodied in the code scheme and the organization of the volume were designed to facilitate the retrieval of information needed in the counseling and placement activities of the Employment Service. The nine-digit code has three parts, as shown in Figure 2-1. The first digit places occupations in one of nine broad categories: four are widely used groupings (professional, technical, and managerial; clerical and sales; service; agricultural, fishery, and forestry); four employ industrial trade terminology (processing; machine trades; benchwork; structural work); and one is a residual category, "miscellaneous."

The first and second digits in combination are refinements of the broader categories and are termed occupational divisions. The 82 divisions are intended to group occupations on the basis of general types of skills or knowledge required; technological objective; type of activity or service; the machines, tools, equipment, or techniques used; or the materials or products produced. Divisions are further subdivided into 559 occupational groups, each defined by a three-digit code, which are intended to provide additional detail on technological objective and on materials, products, subject matter, or services. Thus the first three digits of the code are intended to reflect with increasing specificity the kind of work performed.

The fourth, fifth, and sixth digits of the code are intended to reflect the levels of complexity at which a worker in a particular occupation functions in relation to data, people, and things, respectively. The digits correspond to a structure of 24 worker functions, each of which is denoted by an action verb or verbs, such as "compiling" or "handling" (shown in Figure 2-2). The structure of the worker functions is in the form of three listings that are arranged, in scalelike fashion, from relatively simple tasks (high numbers) to complex tasks (low numbers), such that "each successive

TABLE 2-1 DOT Titles: Description and Frequency

Type	Definition	Defined	Number	Percentage
Base	Title by which occupation is most frequently known.	yes	12,099	42
Master	Title of group of occupations with common tasks and many variations.	yes	15	0
Term	Titles common to a number of jobs that may differ in knowledge required, tasks performed, and job location.	yes	192	1
Alternate	Synonym of base title.	no	8,583	30
Undefined related	Variation or specialization of base title.	no	7,808	27
Alternate to master and term	Synonym of master or term title.	no	104	0
TOTAL			28,801	100

SOURCE: *Dictionary of Occupational Titles* (U.S. Department of Labor, 1977b).

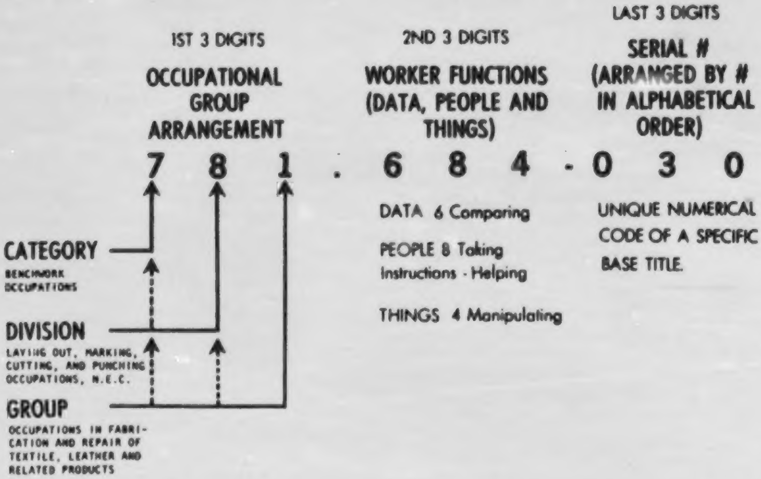
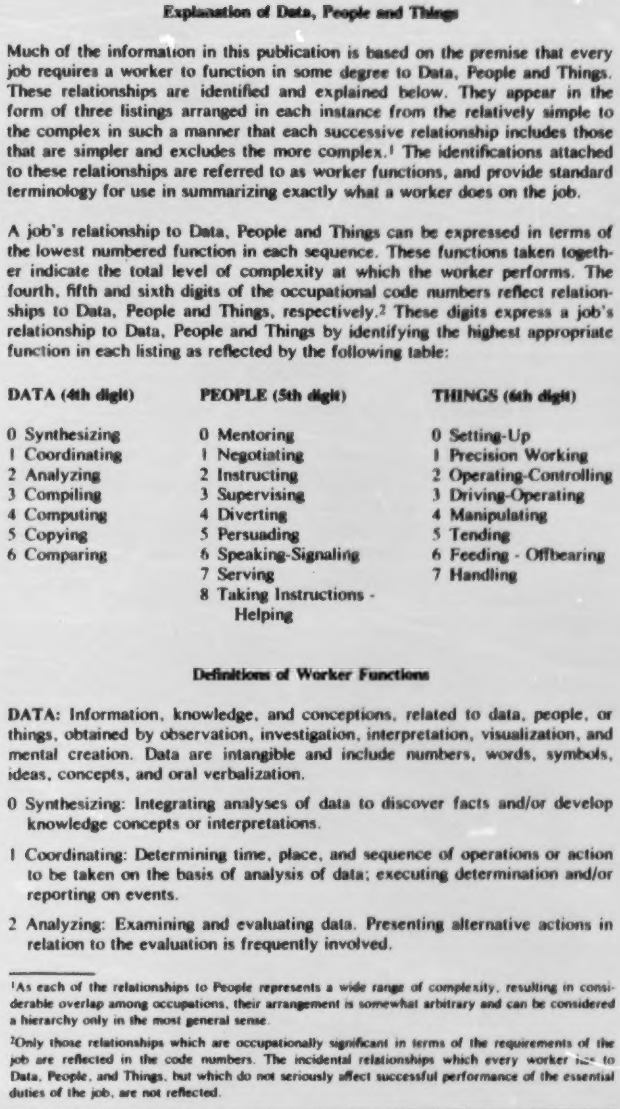

1ST 3 DIGITS
OCCUPATIONAL GROUP ARRANGEMENT
2ND 3 DIGITS
WORKER FUNCTIONS (DATA, PEOPLE AND THINGS)
LAST 3 DIGITS
SERIAL # (ARRANGED BY # IN ALPHABETICAL ORDER)
7 8 1 . 6 8 4 - 0 3 0
DATA 6 Comparing
PEOPLE 8 Taking Instructions - Helping
THINGS 4 Manipulating
UNIQUE NUMERICAL CODE OF A SPECIFIC BASE TITLE.
CATEGORY
BENCHWORK OCCUPATIONS
DIVISION
LAYING OUT, MARKING, CUTTING, AND PUNCHING OCCUPATIONS, N.E.C.
GROUP
OCCUPATIONS IN FABRICATION AND REPAIR OF TEXTILE, LEATHER AND RELATED PRODUCTS

FIGURE 2-1 Parts of the DOT code. Source: *The DOT: Unit III, Trainer's Package for DOT Users* (U.S. Department of Labor, 1977e:22).

relationship includes those that are simpler and excludes the more complex" (Fourth Edition DOT:1369). A disclaimer is made for the PEOPLE function: insofar as each of these functions "represents a wide range of complexity . . . their arrangement is somewhat arbitrary and can be considered a hierarchy only in the most general sense" (Fourth Edition DOT:1369). Occupations are rated for level of functioning; an occupation's relationship to data, people, and things is expressed in terms of the lowest-numbered (or most complex) function for each hierarchy. Properties of the worker function scales are explored further in chapter 7.

The last three digits—or suffix—of the code have no substantive referent. These digits did not appear in earlier editions of the DOT but were issued shortly after the publication of the third edition in a companion volume (U.S. Department of Labor, 1967). They were developed to assist in Employment Service record-keeping when it was discovered that the initial six digits of the code were insufficient to distinguish among specific occupations in many instances. The vital role of these nonsubstantive codes in making distinctions among base titles is evidenced by the fact that there are only 3,963 six-digit combinations among the 12,099 occupations defined in the fourth edition DOT. Suffix codes were assigned to base titles by alphabetizing all titles with the same first six digits. The first title in each set was assigned the suffix code of 010, and the remaining titles were



Explanation of Data, People and Things

Much of the information in this publication is based on the premise that every job requires a worker to function in some degree to Data, People and Things. These relationships are identified and explained below. They appear in the form of three listings arranged in each instance from the relatively simple to the complex in such a manner that each successive relationship includes those that are simpler and excludes the more complex.[1] The identifications attached to these relationships are referred to as worker functions, and provide standard terminology for use in summarizing exactly what a worker does on the job.

A job's relationship to Data, People and Things can be expressed in terms of the lowest numbered function in each sequence. These functions taken together indicate the total level of complexity at which the worker performs. The fourth, fifth and sixth digits of the occupational code numbers reflect relationships to Data, People and Things, respectively.[2] These digits express a job's relationship to Data, People and Things by identifying the highest appropriate function in each listing as reflected by the following table:

DATA (4th digit)	PEOPLE (5th digit)	THINGS (6th digit)
0 Synthesizing	0 Mentoring	0 Setting-Up
1 Coordinating	1 Negotiating	1 Precision Working
2 Analyzing	2 Instructing	2 Operating-Controlling
3 Compiling	3 Supervising	3 Driving-Operating
4 Computing	4 Diverting	4 Manipulating
5 Copying	5 Persuading	5 Tending
6 Comparing	6 Speaking-Signaling	6 Feeding - Offbearing
	7 Serving	7 Handling
	8 Taking Instructions - Helping	

Definitions of Worker Functions

DATA: Information, knowledge, and conceptions, related to data, people, or things, obtained by observation, investigation, interpretation, visualization, and mental creation. Data are intangible and include numbers, words, symbols, ideas, concepts, and oral verbalization.

0 Synthesizing: Integrating analyses of data to discover facts and/or develop knowledge concepts or interpretations.

1 Coordinating: Determining time, place, and sequence of operations or action to be taken on the basis of analysis of data; executing determination and/or reporting on events.

2 Analyzing: Examining and evaluating data. Presenting alternative actions in relation to the evaluation is frequently involved.

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[1] As each of the relationships to People represents a wide range of complexity, resulting in considerable overlap among occupations, their arrangement is somewhat arbitrary and can be considered a hierarchy only in the most general sense.

[2] Only those relationships which are occupationally significant in terms of the requirements of the job are reflected in the code numbers. The incidental relationships which every worker has to Data, People, and Things, but which do not seriously affect successful performance of the essential duties of the job, are not reflected.

FIGURE 2-2 Definitions of the worker function scales represented in the fourth, fifth, and sixth digits of the DOT code. Source: *Dictionary of Occupational Titles* (U.S. Department of Labor, 1977b:1369–1371).

3. **Compiling:** Gathering, collating, or classifying information about data, people, or things. Reporting and/or carrying out a prescribed action in relation to the information is frequently involved.

4 **Computing:** Performing arithmetic operations and reporting on and/or carrying out a prescribed action in relation to them. Does not include counting.

5 **Copying:** Transcribing, entering, or posting data.

6 **Comparing:** Judging the readily observable functional, structural, or compositional characteristics (whether similar to or divergent from obvious standards) of data, people, or things.

PEOPLE: Human beings; also animals dealt with on an individual basis as if they were human.

0 **Mentoring:** Dealing with individuals in terms of their total personality in order to advise, counsel, and/or guide them with regard to problems that may be resolved by legal, scientific, clinical, spiritual, and/or other professional principles.

1 **Negotiating:** Exchanging ideas, information, and opinions with others to formulate policies and programs and/or arrive jointly at decisions, conclusions, or solutions.

2 **Instructing:** Teaching subject matter to others, or training others (including animals) through explanation, demonstration, and supervised practice; or making recommendations on the basis of technical disciplines.

3. **Supervising:** Determining or interpreting work procedures for a group of workers, assigning specific duties to them, maintaining harmonious relations among them, and promoting efficiency. A variety of responsibilities is involved in this function.

4 **Diverting:** Amusing others. (Usually accomplished through the medium of stage, screen, television, or radio.)

5 **Persuading:** Influencing others in favor of a product, service, or point of view.

6 **Speaking-Signaling:** Talking with and/or signaling people to convey or exchange information. Includes giving assignments and/or directions to helpers or assistants.

7 **Serving:** Attending to the needs or requests of people or animals or the expressed or implicit wishes of people. Immediate response is involved.

8 **Taking Instructions-Helping:** Helping applies to "non-learning" helpers. No variety of responsibility is involved in this function.

THINGS: Inanimate objects as distinguished from human beings, substances or materials; machines, tools, equipment and products. A thing is tangible and has shape, form, and other physical characteristics.

0 **Setting up:** Adjusting machines or equipment by replacing or altering tools, jigs, fixtures, and attachments to prepare them to perform their functions,

FIGURE 2-2 Continued

change their performance, or restore their proper functioning if they break down. Workers who set up one or a number of machines for other workers or who set up and personally operate a variety of machines are included here.

1 Precision Working: Using body members and/or tools or work aids to work, move, guide, or place objects or materials in situations where ultimate responsibility for the attainment of standards occurs and selection of appropriate tools, objects, or materials, and the adjustment of the tool to the task require exercise of considerable judgment.

2 Operating-Controlling: Starting, stopping, controlling, and adjusting the progress of machines or equipment. Operating machines involves setting up and adjusting the machine or material(s) as the work progresses. Controlling involves observing gages, dials, etc., and turning valves and other devices to regulate factors such as temperature, pressure, flow of liquids, speed of pumps, and reactions of materials.

3 Driving-Operating: Starting, stopping, and controlling the actions of machines or equipment for which a course must be steered, or which must be guided, in order to fabricate, process, and/or move things or people. Involves such activities as observing gages and dials; estimating distances and determining speed and direction of other objects; turning cranks and wheels; pushing or pulling gear lifts or levers. Includes such machines as cranes, conveyor systems, tractors, furnace charging machines, paving machines and hoisting machines. Excludes manually powered machines, such as handtrucks and dollies, and power assisted machines, such as electric wheelbarrows and handtrucks.

4 Manipulating: Using body members, tools, or special devices to work, move, guide, or place objects or materials. Involves some latitude for judgment with regard to precision attained and selecting appropriate tool, object, or material, although this is readily manifest.

5 Tending: Starting, stopping, and observing the functioning of machines and equipment. Involves adjusting materials or controls of the machine, such as changing guides, adjusting timers and temperature gages, turning valves to allow flow of materials, and flipping switches in response to lights. Little judgment is involved in making these adjustments.

6 Feeding-Offbearing: Inserting, throwing, dumping, or placing materials in or removing them from machines or equipment which are automatic or tended or operated by other workers.

7 Handling: Using body members, handtools, and/or special devices to work, move or carry objects or materials. Involves little or no latitude for judgment with regard to attainment of standards or in selecting appropriate tool, object, or material.

FIGURE 2-2 Continued

assigned codes at intervals of four in order to allow for later insertions. An occupation with a unique six-digit code was assigned the suffix code of 010.

INDUSTRY DESIGNATION

For each base title an industry designation is presented. The industry designation is included to aid users in distinguishing among different occupations with identical titles. For example, the title Pellet-Press Operator is used for three different DOT occupations, depending on whether the accompanying industry designation is "ammunition," "chemical," or "ore dressing, smelting, refining."

The industry designations used in the DOT were specially developed for it and originated with the first edition (1939). They thus reflect the industrial terminology and classifications in use at that time, although modifications have been made in later editions. For example, the designations "military services" and "social services" were included for the first time in the fourth edition.

Strictly speaking, the term "industry" is a misnomer. Although for some titles the designated setting is industrial, for many others the industry designation is actually a broad occupational grouping. For example, "clerical" is used as the industry designation for more than 600 occupational titles; "professional and kindred" is used for another 1,000. Also included among the designations is an "any industry" category. This category contains hundreds of occupations that occur in a number of industries (sometimes in virtually all industries). The category is essentially a catchall, containing, for example, such diverse occupations as Accordian Repairer, Elevator Operator, Miller, Cornice Upholsterer, and Artists' Model. A title's industry designation is indicative but not restrictive, i.e., an occupation may be found in industries other than the one specified. Each designation is defined in an appendix, which also indexes occupational titles by their industry designation.

DEFINITIONS

The DOT titles are defined according to a highly structured format. Each definition begins with a lead statement that is intended to summarize the occupation in terms of (1) worker actions, including instructions followed or judgments made, expressed by specific action verbs in the present tense, (2) work fields, which are the purpose of worker actions (i.e., what gets done on the job), (3) machines, tools, equipment, and/or work aids (MTEWA) used by workers in performing their jobs, and (4) materials,

1. WORKER ACTION-

Indicates what the worker does, and is expressed by Action Verbs in the present tense.

Some examples: LOADS...
DISASSEMBLES...
CONTROLS...
INTERVIEWS...

2. MACHINES, TOOLS, EQUIPMENT, AND/OR WORK AIDS-

Indicates the devices used by workers to assist them in performing their job.

Some examples: Loads INJECTION MOLDING MACHINE (machine)...
Disassembles gear shift mechanism using AIR WRENCH (tool)...
Controls GAS FURNACE (equipment)...
Interviews clients using PROCEDURES MANUAL (work aid)...

3. PURPOSE OF THE WORKER ACTIONS-

Indicates what gets done.

Some examples: Loads injection molding machine TO MOLD...
Disassembles gear shift mechanism using air wrench TO REPAIR..
Controls gas furnace TO MELT...
Interviews clients using procedures manual TO ASSESS...

4. MATERIALS, PRODUCTS, SUBJECT MATTER, AND/OR SERVICES-

Some examples: Loads injection molding machine to mold GRANULATED RESIN PELLETS (materials) into PLASTIC BOTTLES (products)...

Disassembles GEAR SHIFT MECHANISM (material) using air wrench to repair TRANSMISSIONS (material)...

Controls gas furnace to melt STEEL (materials)...

Interviews CLIENTS (subject matter) using procedures manual to assess BACKGROUND AND ATTRIBUTES (subject matter) FOR VOCATIONAL GUIDANCE AND COUNSELING (subject matter), AND REFERRAL TO EMPLOYMENT TRAINING OPENINGS (service)...

FIGURE 2-3 Examples of the four categories of information as the basis of the DOT definition. Source: *The DOT: Unit III, Trainer's Package for DOT Users* (U.S. Department of Labor, 1977e:iii–20).

products, subject matter, and/or services (MPSMS) that a worker produces on the job. The distinctions among these four are illustrated in Figure 2-3.

The lead statement is followed by one or more task element statements, which describe the specific tasks a worker performs to accomplish the overall purpose of the job. Figure 2-4 presents a DOT definition, diagramed to show its component parts. In the first example the task element statements "turns handwheel . . . ," "turns screws . . . ," and "sharpens doctor . . . " indicate how the occupation Cloth Printer is actually performed.

Many definitions also contain job variables, so-called may items, which designate tasks that have been found to be included in a job in some establishments but not in all. In Figure 2-4, for example, the occupation Cloth Printer may "notify Colorist when color shade varies from specifications."

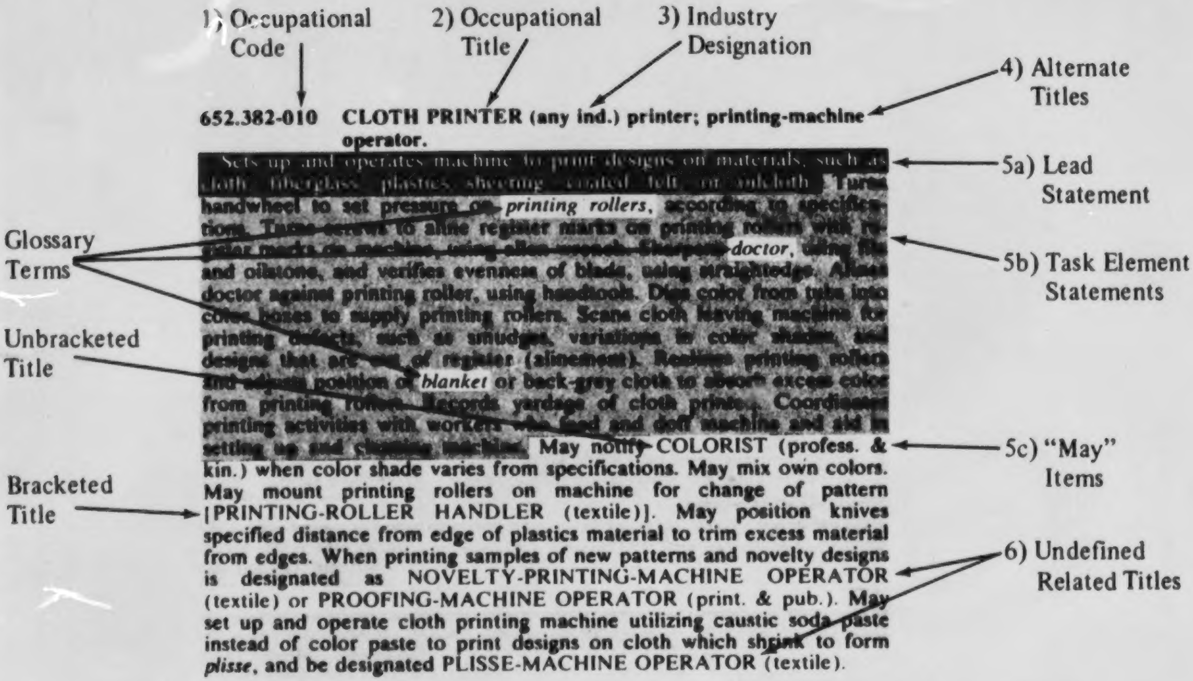
Some definitions contain additional elements. Technical terms or special uses of terms not ordinarily found in a standard dictionary are italicized to indicate that they are defined in the DOT's glossary. Bracketed titles in a definition indicate that workers in the base title may also, on occasion, perform some of the duties of the bracketed occupation. Unbracketed titles (e.g., Colorist in the example) denote occupations with which the occupation being defined frequently works. Examples of these three features are found in Figure 2-4. Slightly different occupations with the same title in the same industry are designated by a roman numeral following the title. For example, the title Surgeon I indicates that there are other occupations with this title in the medical services industry. Finally, some definitions contain a statement of significant variables. Distinct from a may item, which refers to specific job tasks, this statement lists other related jobs that are covered by a particular definition. It is included to reduce the number of nearly identical definitions in the DOT.

ADDITIONAL FEATURES

Although titles are presented in order of their codes in the fourth edition, the DOT contains alphabetical and industry designation indexes designed to assist users in locating job or occupational titles about which they have limited information. To assist users further in locating titles and interpreting the information available about them, the DOT provides 25 pages of introductory instructions that explain the DOT code, definitions, indexes, and other features of the *Dictionary of Occupational Titles*. A 16-page glossary of technical terms is also provided.

RELATED PUBLICATIONS

A number of publications closely related to the fourth edition were planned at the time of its publication. Many of these publications use, in one form or another, information about worker traits, the attributes considered to be required of workers performing a particular occupation. This information was collected during the course of job analysis for the



652.382-010 **CLOTH PRINTER** (any ind.) printer; printing-machine operator.

Sets up and operates machine to print designs on materials, such as cloth, fiberglass, plastics sheeting, coated felt, or oilcloth: Turns handwheel to set pressure on *printing rollers*, according to specifications. Turns screws to aline register marks on printing rollers with register marks on machine, using allen wrench. Sharpens *doctor*, using file and oilstone, and verifies evenness of blade, using straightedge. Alines doctor against printing roller, using handtools. Dips color from tubs into color boxes to supply printing rollers. Scans cloth leaving machine for printing defects, such as smudges, variations in color shades, and designs that are out of register (alinement). Realines printing rollers and adjusts position of *blanket* or back-grey cloth to absorb excess color from printing rollers. Records yardage of cloth printed. Coordinates printing activities with workers who feed and doff machine and aid in setting up and cleaning machine. May notify COLORIST (profess. & kin.) when color shade varies from specifications. May mix own colors. May mount printing rollers on machine for change of pattern [PRINTING-ROLLER HANDLER (textile)]. May position knives specified distance from edge of plastics material to trim excess material from edges. When printing samples of new patterns and novelty designs is designated as NOVELTY-PRINTING-MACHINE OPERATOR (textile) or PROOFING-MACHINE OPERATOR (print. & pub.). May set up and operate cloth printing machine utilizing caustic soda paste instead of color paste to print designs on cloth which shrink to form *plisse*, and be designated PLISSE-MACHINE OPERATOR (textile).

1) Occupational Code
2) Occupational Title
3) Industry Designation
4) Alternate Titles
5a) Lead Statement
5b) Task Element Statements
5c) "May" Items
6) Undefined Related Titles
Glossary Terms
Unbracketed Title
Bracketed Title

FIGURE 2-4 Parts of a DOT definition. Source: *Dictionary of Occupational Titles* (U.S. Department of Labor, 1977b:xvi).

DOT. Although worker trait information does not appear in the fourth edition DOT, each base title was assigned scores for the types of traits listed below; additional information is provided in chapter 6.

1. Training time, the "amount of general educational development (GED) and specific vocational preparation (SVP) required of a worker to acquire the knowledge and abilities necessary for average performance in a particular job-worker situation" (U.S. Department of Labor, 1972:8). GED includes aspects of formal and informal education that contribute to the worker's reasoning development, the ability to follow instructions, and the use of language and mathematical skills. SVP includes training acquired in a "school, work, military, institutional, or avocational environment" (U.S. Department of Labor, 1972:8) but excludes schooling without specific vocational content.
2. Aptitudes, the capacities or abilities required of a worker to facilitate the learning of job tasks, e.g., intelligence and motor coordination.
3. Temperaments, the personal traits useful to a worker in adjusting to the requirements of his or her job, e.g., adaptability in dealing with people or in performing repetitive tasks.
4. Interests, tastes, and preferences for certain kinds of activities that are entailed in job performance, e.g., a preference for activities involving business contact with people.
5. Physical demands, the physical requirements made of a worker in carrying out job tasks, e.g., strength or stooping.
6. Environmental conditions, the physical surroundings and circumstances in which a job is performed, to which a worker must adapt, e.g., extreme cold or heat.

Specific vocational preparation (SVP) scores were published in an interim edition of the DOT in February 1978. This edition will be superseded by a formal supplement to the DOT (to be published in 1980) that will include SVP and GED estimates as well as ratings on physical demands and environmental conditions.

The recently issued *Guide for Occupational Exploration* (U.S. Department of Labor, 1979a) makes extensive use of information akin to that contained in the worker traits, although it does not use the identical items or the actual ratings themselves. The *Guide* was designed to assist applicants in vocational exploration and choice. In the format and presentation of vocational information, particular attention was paid to the needs of entry-level workers. The *Guide* is organized around a new classification scheme that is said to provide an entry-level classification of occupations.

The classification is based on an interest inventory developed by the U.S. Employment Service's testing division (Droege and Hawk, 1977). For each of 12 interest areas (which are not the same as the worker trait interests described above) a description is provided of the qualities and characteristics workers should possess to perform jobs in a particular area. A listing of representative DOT occupations is also provided for each area. Much of the descriptive material about jobs in the interest areas is presented in a simple question-and-answer format. For counseling and placement purposes the *Guide* can be used alone or in conjunction with an interest inventory that can be self-administered by applicants. In the latter instance, results from the interest inventory can be used for job-worker matching by comparing applicants' test results to the appropriate occupational interest groups. By means of this capability, developers of the *Guide* hope to facilitate the placement of workers with little previous or recent work experience.

SUMMARY

The fourth edition DOT, in conjunction with related publications, provides (1) a dictionary of occupational titles, (2) a classification of occupations, and (3) information about a large number of occupational characteristics in terms of the demands they make on workers. Not surprisingly, given this wealth of information, the DOT is widely used both inside and outside the Employment Service. The next two chapters of this report discuss this use.

3 Use of the *Dictionary of Occupational Titles* by the U.S. Employment Service

Chapters 3 and 4 describe the uses of the *Dictionary of Occupational Titles*. Chapter 3 summarizes the uses of the DOT within the U.S. Employment Service (ES); chapter 4 presents a summary of the uses of the DOT outside the Employment Service. This chapter is intended to provide the general reader with some information about the primary uses made of the DOT by the Employment Service. Detailed descriptions of Employment Service use of the DOT have already been collected and are reported elsewhere.[1]

The major use of the DOT within the Employment Service is as a placement tool in local Employment Service offices for the matching of workers and jobs. It is also used in a variety of counseling and guidance activities. Secondary users of the DOT include the Division of Testing and the Division of Labor Certification, which are the two other subdivisions (in addition to the Division of Occupational Analysis) of the Office of Technical Support in the U.S. Employment Service. Each of these users of the *Dictionary of Occupational Titles* is described in turn. Thoughout the chapter, reference is made to data gathered from site visits to local

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[1] The Employment Service has conducted several surveys of its use of the third edition DOT: in 1967–1968 the Wisconsin occupational analysis field center conducted a four-question, open-ended survey; a second survey was made in 1973 in nine state ES agencies by the occupational analysis field centers; in 1972 the California occupational analysis field center also conducted a study of DOT use in local ES offices.

Employment Service offices as well as to the committee's surveys of DOT purchasers and state-level DOT users. Given the nature of the samples, the ES staff responding to the surveys cannot be regarded as representative of all ES employees.[2] Still, the responses to these surveys provide supplementary information about Employment Service use of the DOT.

USE OF THE DOT IN PLACEMENT AND COUNSELING

A SOURCE OF OCCUPATIONAL INFORMATION

Employment Service placement interviewers and counselors need definitions of those occupations for which employers need workers as well as of those occupations in which workers have previously been employed. It was this need that led to the production of the first edition DOT in 1939.

To understand the current need for the DOT by the Employment Service, committee members and staff observed the operations of local Employment Service offices in various parts of the country and discussed the use of the DOT with experienced interviewers and counselors. Because we did not visit a large number of offices and because the offices we did visit were not specifically selected for their representative character, the descriptions provided do not necessarily represent all, or even the average, Employment Service office. The committee was also briefed at its first meeting by senior officials of the national office of the U.S. Employment Service on the use of the DOT and benefited from published Employment Service documents. Many of the ES staff with whom we spoke suggested that there was an enduring need for a comprehensive set of definitions for the occupational titles that are commonly used to describe jobs in the U.S. economy.

Our observation of local ES offices indicated that even highly experienced Employment Service interviewers may encounter unfamiliar occupational titles. For example, in one local office, committee staff observed a counselor, whose experience was mainly in hotel service occupations, interview an applicant who had recently emigrated from the Soviet Union. The applicant spoke fluent English but did not fully understand the nuances of American occupational titles. After reviewing his application the counselor established that the applicant had been employed in the Soviet telephone system. The interviewer then worked his way through a variety of technical occupations in the telephone industry involving duties similar to those described by the applicant. The counselor began with the occupation Telephone Installer and then proceeded from Telephone Repairer to Electronics Technician. He and the applicant finally settled on the title Electronics Technician as the best description of the job tasks that the worker had performed for the Soviet telephone system. The interview was largely conducted by having the applicant respond to the definitions of various occupational titles in the telephone industry. In this case the availability of a comprehensive set of definitions for the occupational titles used in the U.S. telephone industry was an essential part of assisting the job applicant; the availability of a dictionary of occupational titles enabled an interviewer whose experience was largely confined to hotel service jobs to assist the applicant in finding a suitable job in another industry.

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[2] The DOT purchaser and the state-level surveys carried out by the committee staff were intended to solicit responses from users of the DOT outside the Employment Service (see chapter 4 for details on the sampling design for these surveys). However, because of the lack of specificity in the list of purchasers used as the sampling base, and because of the way the state-level users were chosen, 76 Employment Service employees were inadvertently included as respondents to the survey of external users. These responses were deleted from the analysis of external use of the DOT and used as supplementary information for this chapter (see also footnotes 2 and 5 of chapter 4).

While the foregoing example may be unusual, it does parallel a number of other cases that are more common. Situations may arise in which workers are employed in relatively rare occupations or the occupational titles used in one area of the country are not the same as those used in another area. The *Dictionary of Occupational Titles* is also used to facilitate the training of ES personnel in occupational areas in which they have no direct experience.

PLACEMENT

In addition to the use of its definitions and titles to inform interviewers, counselors, and applicants about the nature of jobs, the DOT classification structure provides a mechanism for job-worker matching. Each worker applying for a job and each job opening placed with the Employment Service is assigned a DOT code number designating the relevant occupation. These codes are used to match job openings in a particular occupation with workers seeking employment in that occupation as well as to report aggregate operating statistics on the types of workers served and the types of job vacancies existing in various local labor markets.

The committee staff visited a number of Employment Service offices, both automated and nonautomated. A composite picture of the typical job search procedure is presented below, drawn from local office visits and Employment Service documents. For the job-seeking client entering the employment office, there are three basic methods of job search or referral once the initial reception and application work is completed. Most of the applicants (75 percent in one center visited) are sent directly to microfiche viewers through which they can review existing job openings, sorted by DOT code. If they find jobs that are of interest, they then meet with a placement interviewer. Certain clients are referred immediately to placement interviewers, because either their skills are in great demand or they require special help in completing their application (e.g., they cannot read or lack sufficient proficiency in English). Other clients—usually the very young, very old, disabled, or non-English-speaking—are usually routed directly to guidance counselors. The first two of these methods of job search are described in this section; the counseling process is described in the subsequent section.

Self-Referral

Most local Employment Service offices have set aside a portion of the office as a job information service, which provides job search information. The existence of a job information service system rests on the premise that many job seekers can secure employment with minimal assistance from interviewers. The Employment Service has set up a self-help unit to which job applicants can go to review existing job openings. In addition to job search information (e.g., pamphlets and career brochures) this unit contains microfiche viewers listing job openings by DOT code. Clients are directed to appropriate viewers on the basis of their past employment experience, as indexed by the nine-digit DOT code. The job bank microfiche contains all the job orders submitted through the previous day; in automated centers it contains keywords (discussed in Appendix G) as well as the DOT code. When a job seeker has found one or more jobs of interest, he or she meets with a placement interviewer who consults the microfiche as well as the application form to determine whether the client meets the employer's specifications. The interviewer then checks to be sure that the employer is still accepting referrals and if so sets up an interview.

Interviewer Referral

Some of the clients using the job information service may also be directed to placement interviewers who help them search for jobs. Other applicants are referred directly to interviewers upon entry to the employment office, either because their skills are in great demand or because they encounter problems in filling out the application forms or using the microfiche viewers.

The method of job search employed by the placement interviewers depends on whether the employment office is automated. In a nonautomated office each interviewer generally specializes in a certain group of jobs (i.e., a particular range of DOT codes). Duplicate copies of a client's application must therefore be placed in separate files, one for each DOT code assigned to the client. In assisting a client in finding employment the interviewer manually searches through job orders and through the job information service microfiche in order to find a suitable job-worker match. Finding such a match, the interviewer sets up an interview for the applicant. The client's file is kept for 60 days, during which time the interviewer attempts to fill new job orders with past applications. Although many placements are found this way (in one center this type of placement was 3 times as likely as same-day placements), the interviewers complained that it is hard to find time for such searches when long lines of applicants await service.

In automated offices the interviewer-assisted job search is conducted in a different way. Two types of computer-assisted matching techniques are employed: an applicant-oriented procedure and an employer-oriented procedure. The former procedure typically makes an immediate referral, while the latter is done in an "overnight batch match." In the applicant-oriented search, the interviewer searches the job bank via computer to find jobs matching the client's skills and requirements for time, pay, and location. The matching jobs are usually printed out with an estimate of the degree to which the match satisfies the employer's requirements. The interviewer assists in choosing among the matching jobs and makes a referral. If no referral is made via the applicant-oriented search procedure, the client may still receive a job referral from the employer-oriented matching procedure. In this method of job-worker matching, a computer is used to find the best-fitting applicants for each job in the job bank; for each job, applicants are ranked by fit to the job.

Before moving on to a description of counseling, mention should be made of how job orders from employers are handled in Employment Service offices. Special interviewers, not involved in placement, accept job orders by phone, recording in a standardized way information on place, limitations on the number of referrals, salary, benefits, and job requirements. In automated centers this information is coded directly into the computer via a keyword language so that the jobs are available for immediate referral. In both types of centers a DOT code is assigned to each job order by the order taker.

COUNSELING

Certain Employment Service clients—including veterans and disabled, illiterate, very young, very old, or non-English-speaking people—are usually routed directly to vocational guidance counselors rather than to the job information service unit or a placement interviewer. Employment Service counselors assist job seekers with problems related to vocational choice, occupational change, and job adjustment. Since the counseling program is ultimately designed to result in occupational placement, Employment Service counselors may serve the dual role of placement interviewer/counselor.

The counselor, when interviewing individual clients, attempts to assist the job seeker in developing an occupational plan, identifying both short-range and long-range vocational goals. In developing such a plan, the counselor collects relevant identifying information, a summary of the applicant's vocational situation, and additional facts that may be relevant (e.g., vocational likes and dislikes, work experience, educational background). As part of the counseling process the counselor may use ES-approved tests, such as interest inventories, interest checklists, and aptitude tests, to assess the individual's skill level, aptitudes, or interests. With this information the counselor can then work with the job seeker in developing an occupational plan to be followed. The overall purpose of the counseling program is to evaluate, with the applicant, his or her current qualifications and potential occupational aptitudes and to compare them with job requirements and opportunities as indexed by the DOT code and other worker trait data. A new automated system has been designed to assist in the counseling/placement function: the systems exploration and research for career help (SEARCH) is a computer-assisted system that compares the interests, aptitudes, and abilities of a client with those required by the jobs in which he or she has expressed an interest.

The national office and the state occupational analysis field centers of the U.S. Employment Service have also engaged in a variety of counseling and guidance support activities. A recent major effort was the publication of the *Guide for Occupational Exploration* (U.S. Department of Labor, 1979a).[3] This guide, written in simple language, groups together occupations that are "homogeneous in terms of worker characteristics." The worker characteristics that define these worker trait groups derive from job analysis schedules completed for the DOT and include general educational development (GED); specific vocational preparation (SVP); the DATA, PEOPLE, and THINGS ratings; aptitudes, interests, temperaments, physical demands, and working conditions. This information is reformatted to facilitate counseling. The *Guide for Occupational Exploration*, which stems from an ES tradition of publishing career guidance material based on the DOT, illustrates a major and continuing use of DOT material. The

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[3] An adaptation of this work was published commercially (Appalachian Educational Laboratory, 1978).

Employment Service has also published a number of books and pamphlets describing occupations and employment possibilities in various industries, such as *Occupations in Library Science, Career Opportunities in the Trucking Industry, Health Careers Guidebook* (see Appendix D for a listing of occupational analysis publications). In general, these publications reformat information from the DOT with basic information about an industry, its organization, and its hiring practices.

EVALUATION OF DOT USE

Several assessments of local office use of the *Dictionary of Occupational Titles* in placement and counseling have been conducted by the Employment Service. This section provides a summary of these evaluations as well as supplemental information provided by the committee-sponsored surveys of DOT purchasers and state-level DOT users. The Employment-Service-sponsored surveys of DOT use were carried out before 1974 and describe the use of editions prior to the fourth edition, whereas the committee-sponsored surveys cover both the third and the fourth editions.

The ES studies include (1) a survey conducted by the Wisconsin occupational analysis field center in 1967–1968, (2) a small survey conducted in 1972 by the Los Angeles occupational analysis field center, and (3) a 1973 survey of DOT use in nine state Employment Service offices, conducted by the occupational analysis field centers. The 1973 study, more comprehensive in scope than the previous surveys, surveyed 569 employment personnel in more than 220 local offices in New York, North Carolina, Florida, Michigan, Wisconsin, Texas, Missouri, Arizona, and Washington. Those surveyed included placement interviewers, counselors, job development and training specialists, unemployment personnel, and technical, support, and management staff. While some of the information gathered by this survey is limited because the referent is the third edition DOT, many of the essential features of the DOT and its use by the Employment Service have not changed.

All three Employment Service surveys suggest that the DOT job titles and definitions are the most frequently used DOT components. Of the 1973 respondents, 97 percent reported using the titles and definitions at least occasionally. Respondents reported less frequent use of the occupational group arrangement, the industry designation, worker functions, and worker trait information.

In the 1973 survey, approximately 60 percent of the placement interviewers reported that they never used the worker trait information, and another 37 percent reported that they used it only occasionally. Employment Service counselors are more likely to find the worker trait information useful: 12 percent of the counselors reported frequent use, and another 68 percent reported occasional use of the worker trait information. Three quarters of the counselors found the worker trait information useful in helping clients explore vocational and occupational options.

Two thirds of the counselors and 82 percent of the interviewers reported that they used the occupational group arrangement (the DOT classification structure) at least occasionally. Those who used the occupational group arrangement reported that they did so for order taking, to classify occupations and applicants, to find appropriate occupational titles, to assign codes to entry-level workers, or to relate occupations to the aptitude and the general aptitude test battery (GATB) scores of applicants.

Seventy percent of the counselors and sixty-two percent of the interviewers found the industry designations useful for their work. The counselors used the industry designation for differentiating among similar titles and identifying related occupations for counseling and job development, while interviewers employed it for finding similar jobs in related fields, coding jobs and applicants, defining industries and defining jobs within them for job development, and as help in identifying applicant skills.

The majority of counselors and interviewers also found the worker function information (the fourth, fifth, and sixth digits of the DOT code) helpful in their work. Two thirds of the counselors reported that the worker function data were of significant value in their work; 60 percent of the interviewers expressed similar sentiments.

These survey data are in general agreement with the observations made during committee-sponsored site visits to local Employment Service offices. In particular, it was observed that order takers, interviewers, and unemployment insurance personnel usually consult the dictionary to locate an occupational title and DOT code; they less frequently use it for other purposes. In visits to offices made while the third edition DOT was still being used, we observed that typically, Volume 1 was consulted; that volume contains occupational titles arranged in alphabetical order, with a definition and a DOT code number for each title. The DOT supplement containing three-digit suffix codes was also usually consulted to provide a unique nine-digit code. Ordinarily, placement staff did not consult the worker trait and occupational group information published in the second volume. This volume appears to be used in unusual cases (e.g., involving applicants with special counseling needs or for job development or testing work).

In many offices it is impossible for an interviewer to serve a new applicant or employer without using the title and definition sections of the DOT. Some offices have an explicit policy that requires the consultation of the DOT to verify all occupational titles and codes. In other offices there is no explicit rule, and, occasionally, one observes interviewers using personal lists of DOT codes for common occupational titles, a practice that is more common in nonautomated offices in which ES personnel specialize in a particular industry or a range of occupations.

In the 1973 survey, respondents were also asked to assess the usefulness of the various components of the DOT. Many respondents drew attention to the need for cross-references between similar occupations in the DOT as well as to the DOT's inconsistency in the detail of its occupational definitions; 67 percent of the ES counseling personnel believed that related DOT definitions should be cross-referenced to facilitate career exploration. In addition, complaints were voiced about the placement of dissimilar jobs in the same group in the DOT's occupational group arrangement, which meant that the grouping arrangement could not be relied on to locate occupations with related skills.

The Employment Service respondents to the committee-sponsored survey of DOT users (see note 2) provide interesting supplementary and corroborating information to the evaluation of use described above. Of the 76 respondents, 28 are placement personnel; another 28 are involved in the development of labor force projections and occupational information dissemination; 8 are in counseling work; the remainder conduct research or are located in vocational education or managerial positions. Of these respondents, 92 percent reported that they had used the fourth edition DOT in the past year; 67 percent were also still using one of the two primary third edition volumes (i.e., *Definitions of Titles* (U.S. Department of Labor, 1965a) and *Occupational Classification and Industry Index* (U.S. Department of Labor, 1965b)). As suggested by the ES-sponsored surveys, Employment Service staff find the titles and definitions as well as the DOT codes themselves particularly useful; 91 percent of the ES respondents reported that they use the titles and definitions and 87 percent use the codes. About half the respondents report using the industry designations (placement personnel more often than counselors) and the worker trait information (counselors more often than placement interviewers).

Although the DOT appears to be quite important to local ES employees (at least specific component parts of the DOT), the career-related brochures sponsored by the Division of Occupational Analysis are apparently not so important. The occupational analysis career guides and brochures are generally used by fewer than a third of the Employment Service respondents. This finding is surprising, given that the local ES offices are the primary distribution point for these publications. By contrast, the job search monthlies published by the Job Search Branch of the Division of Occupational Analysis (e.g., *Job Bank Openings Summary, Frequently*

Listed Openings, and *Occupations in Demand*) are widely used. Nearly two thirds of the ES respondents (primarily employment placement personnel and those involved in labor force projections and the dissemination of occupational information) reported regular or occasional use of these products in the past year.

Although the casual nature of our sample of ES personnel precludes strong inferences from their responses, the lack of use of career products within local ES offices is consistent with the observations of the committee and staff made in the course of visits to ES offices and is corroborated by the findings of Booz, Allen & Hamilton, Inc. (1979:IV-17). Booz, Allen & Hamilton asked ES employees about career publications of the Occupational Analysis Branch but not about the products of the Job Search Branch. They concluded that the production of career brochures by the national office was poorly directed and not cost effective. In interviews with local Employment Service staff, including job information service unit supervisors, career counselors, and office managers, the Booz, Allen & Hamilton staff did not find anyone familiar with the national career publications. The state-produced brochures, in contrast, were considered valuable and were in heavy demand at the local offices visited.

Although not a publication of the Employment Service, the *Occupational Outlook Handbook* (U.S. Department of Labor, 1978a), published every 2 years by the Bureau of Labor Statistics, exemplifies one other major use of the DOT within the Department of Labor. This large document is a major source of vocational guidance used by school and career counselors. For each DOT occupation the *Handbook* collects and reformats DOT and other information describing what workers do in that occupation, the training and education required, and projections of the likely availability of jobs in the future. This publication is evidently used often by local ES office employees; 90 percent of the Employment Service respondents to our survey of DOT users reported regular or occasional use in the past year.

OTHER USES OF THE DOT

TESTING

As mentioned earlier, Employment Service counselors and interviewers may recommend that their clients take one or more tests designed to assist both job seekers and employers in maximizing job-worker placement. These tests, designed by research psychologists in the Division of Testing of the Employment Service, assess applicant aptitudes and interests with respect to a variety of occupational options; they are intended to measure basic achievement levels, interests, proficiencies, and potential. Counselors can use this information in exploring career opportunities and options with ES clients. The testing program is also seen as benefiting prospective employers by permitting the referral of applicants who have demonstrated potential or interest in a particular occupation.

A variety of tests, developed by the Division of Testing, are currently being employed in local ES offices.

General Aptitude Test Battery (GATB). The GATB, published in 1947 after extensive occupational validation and factor analysis studies, measures the vocational aptitudes of individuals who possess basic literacy skills but who have requested help from ES counselors in selecting an occupation. The test battery contains 12 tests measuring 9 vocational aptitudes, including general learning ability; verbal, numerical, and spatial aptitudes; form perception; clerical perception; motor coordination; finger dexterity; and manual dexterity. The test is intended to measure an individual's vocational aptitudes, and scores are interpreted as indicating qualifications for a wide range of occupations.

Non-Reading Aptitude Test Battery (NATB). The NATB is an analogue of the GATB for individuals with insufficient reading skills to take the GATB. In this test battery, 14 tests measure the same 9 aptitudes measured by the GATB.

Specific Aptitude Test Batteries (SATB). The SATB are subsets of the GATB, with associated cutoff scores, used to measure an applicant's potential to acquire skills relevant to specific categories of occupations.

Clerical Skills Test. The clerical test is designed to measure proficiency in typing, dictation, and spelling for clerical occupations.

Basic Occupational Literacy Test (BOLT). The BOLT is a measure of the literacy skills of educationally deficient applicants that can be related to the literacy requirements of specific occupations.

Interest Check List. The Interest Check List was developed by the Division of Testing for use during the counseling process in order to obtain information on the occupational interests of the job seeker. The checklist contains 173 sample tasks that represent a wide range of occupational activities.

In addition to these counseling aids, the Division of Testing has also been partly responsible for the development of a new occupational interest inventory that was recently published in the *Guide for Occupational Exploration*, a supplement designed to be used with the fourth edition DOT. The purpose of the research was to make available to counselors an interest inventory that directly relates the job seeker's capabilities, occupational interests, and adaptabilities to the requirements of occupations.

The Division of Testing relies on the DOT for information on occupations and occupational requirements both in producing their tests and, as described above, in applying the tests in counseling and placement uses in local ES offices. According to the Division of Testing their development and research program is guided by several concepts (U.S. Department of Labor, 1977g:1–2):

> The tests developed must be occupationally oriented if they are to be useful in vocational counseling and selection in the Employment Service.
>
> To the extent possible, the tests developed should be oriented to the U.S. Employment Service's *Dictionary of Occupational Titles* used by placement interviewers and counselors in the Employment Service.

Specifically, these ES-produced tests are related to the DOT coding structure, in which occupations are identified by DOT codes. The reliance of the testing program on the DOT is seen most strongly, however, in the use of the DOT to define the occupations for which test norms are produced. For example, the basic literacy test (BOLT) establishes literacy standards for DOT occupational groups by reference to the general educational development (GED) levels defined in the DOT.

LABOR CERTIFICATION

One other use of the DOT in the Employment Service is in the job placement of alien workers. As amended in 1965, the Immigration and Nationality Act allowed foreign workers to enter the United States if they offered a skill that U.S. workers could not provide. This provision ensured that foreign workers would not be competing with U.S. citizens for jobs. The Division of Labor Certification is the office within the Department of Labor charged with making such determinations, and the DOT is the primary source document used in the certification process. The division does not generally make any statements regarding surplus or shortage job areas; all work to be certified concerns a specific job opportunity, as indexed by a nine-digit DOT code. The foreign worker must be sponsored by an employer, who contacts the division for certification once the employer has attempted to fill the job through normal Employment Service procedures. If the job, indexed by the nine-digit DOT code, is certified, the Immigration and Naturalization Service gives the worker a temporary visa. The division also maintains a list of occupations that are found to be in short supply nationally.

In addition to the work of the Division of Labor Certification the field centers of the Division of Occupational Analysis have also been involved in labor certification work. The New York field center was called on to determine whether French Canadian workers in Maine were performing logging operations not done by American workers. If an occupation not performed by American workers was found to exist, this fact could be used as justification for allowing the Canadian workers to remain in the country. The foreign workers evidently performed all three of the operations normally involved in logging work, while American workers traditionally specialized in only one of the three. The contribution of the occupational analysts to this project was to provide documentation justifying the creation of a new, more general occupation to be included in the DOT, thus providing the alien loggers the certification they needed to remain in the country.

The Arizona field center is currently (at the time of writing) involved in a similar labor certification case. The state's citrus growers want to import Mexican pickers, since they claim that U.S. workers with the 1–2 years of experience necessary to do the work are not available. On the basis of the existing SVP score for citrus workers (SVP = 1, short demonstration only) the state Employment Service has denied the growers' request for labor certification of alien workers. To resolve the controversy, the Arizona field center has been asked to ascertain whether the SVP rating is appropriate.

SUMMARY

This chapter briefly summarizes the primary uses of the *Dictionary of Occupational Titles* within the U.S. Employment Service. The major use of the DOT is as a placement and counseling tool for matching workers and jobs in Employment Service offices. Information from a variety of sources suggests that the major use of the DOT for placement purposes involves its dictionary capacity: the great majority of ES employees indicate that they make primary use of the job titles and definitions. Another substantial percentage indicate heavy use of the DOT coding structure. Less use is generally made of the other components of the DOT, including the industry designation, the worker function scales, and the worker trait information. Counselors were more likely than placement interviewers to find the worker trait information useful; 75 percent reported using this information in helping clients to explore vocational and occupational options.

In addition to its use as a placement and counseling tool the DOT also provides the factual base for a series of career brochures and monthly labor force information publications prepared for use by counseling and guidance personnel in local ES offices. With the exception of the job search monthlies (*Job Bank Openings Summary, Frequently Listed Openings*, and *Occupations in Demand*) the career guides and other occupational information produced by the Division of Occupational Analysis are apparently almost never used by ES personnel.

The DOT is also used by the Division of Testing and the Division of Labor Certification, two subunits of the Employment Service. The testing program uses the DOT in the development of tests for the ES counseling process. The tests are designed to measure occupational aptitudes, clerical skills, and literacy. The use in labor certification is for indexing occupational opportunities for which the demand for workers exceeds the supply of eligible U.S. workers, thus permitting the certification of foreign workers.

4

Use of the *Dictionary of Occupational Titles* Outside the U.S. Employment Service

In accordance with its charge, the committee undertook an assessment of the current and projected need for the *Dictionary of Occupational Titles* (and other program products) outside the U.S. Employment Service. As described in chapter 3, the DOT was originally designed for use as a job-matching tool for the U.S. Employment Service. Since 1939, when the first edition was published, the DOT has gained widespread acceptance and has been widely used by agencies and organizations outside the Employment Service. Since there has been no previous description of these users, one of the charges to the committee was to document the uses made of the DOT and assess the prevalence of these uses. We have approached this objective in several ways: (1) through a probability survey of persons who had recently purchased the DOT, (2) by interviews and site visits at organizations and agencies identified as institutional users of products of the Division of Occupational Analysis (OA), these interviews being supplemented by a survey of persons identified as users of the DOT at the state level, and (3) through inquiries of researchers who had used the DOT in their work or had evaluated the DOT itself, to develop an annotated bibliography of research uses of the DOT.

Patricia A. Roos had primary responsibility for the preparation of this chapter.

COLLECTING DATA ON DOT USES

DESCRIPTION OF THE UNIVERSE

Because the *Dictionary of Occupational Titles* is the most heavily used publication of the Division of Occupational Analysis, we concentrated our attention on the kinds and extent of use made of the DOT. The distribution and use of the career publications and other OA products are discussed at the end of the chapter.

Figure 4-1 depicts the distribution of the fourth edition *Dictionary of Occupational Titles* since its publication in December 1977. These numbers were derived from consultation with the staff of the Government Printing Office, the Department of Labor, and the individual agencies to which the DOT was distributed. The federal agencies in the top half of Figure 4-1 are those that "rode the requisition" for the DOT, that is, placed bulk orders supplementary to the basic requisition by the Department of Labor. In addition to these agencies other individuals, groups, and organizations ordered their copies directly from the Government Printing Office (GPO). Approximately 201,000 copies of the DOT have been printed for sale, and by September 30, 1979, 115,115 had been sold. A large portion of these were sold through bulk orders, either to GPO distribution centers or to college textbook centers.

It is instructive to note that in the first 14-month period following the publication of the third edition DOT, 40,654 copies were sold; the comparable figure for the fourth edition was 100,198 copies. The total number of third edition copies sold from its 1965 publication date through the end of 1977 (when it went out of print) was 148,145. Clearly, interest in the information provided by the DOT has increased dramatically since publication of the third edition.

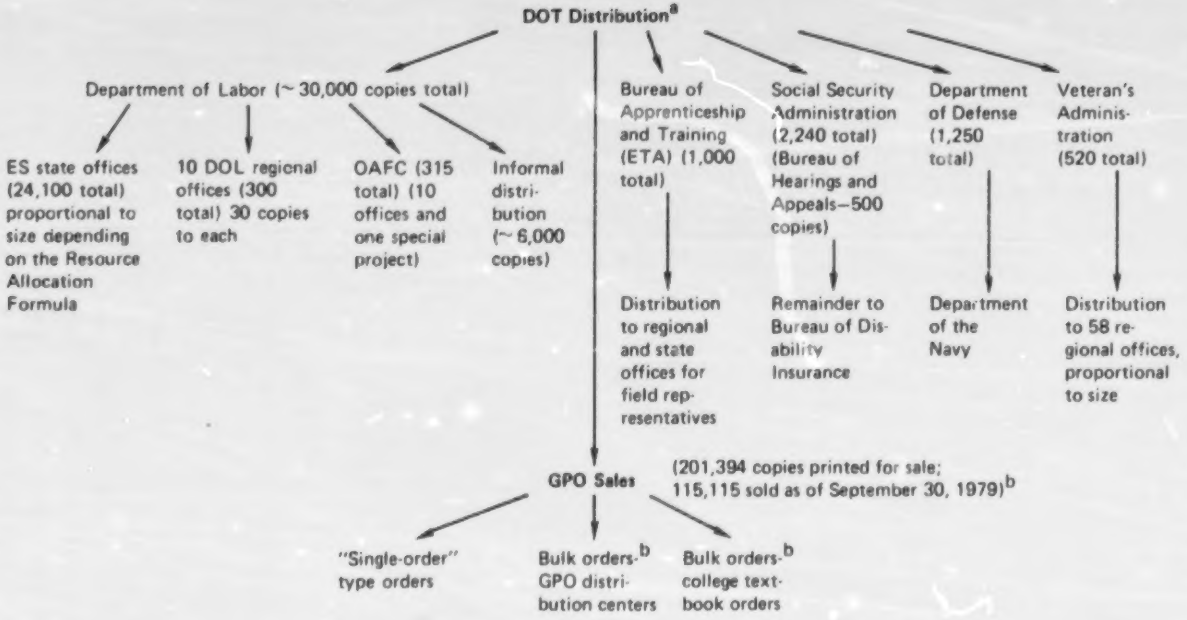
SAMPLING DESIGN

Given the complex distribution of the DOT, the development of an adequate sample of DOT users outside the Employment Service represented something of a challenge. Consideration of Figure 4-1 conveys the nature of the difficulty. First, many copies were purchased in bulk by federal agencies and distributed to relevant staff, and no record was kept as to who received copies. To tap this part of the universe of users, we conducted site visits with agency personnel to determine what sort of institutional use was being made of the DOT. Second, the GPO sold the DOT in two ways: directly to individual parties through single-order purchases and indirectly through bulk orders from GPO distribution centers and college textbook distribution firms. For the direct sales to individuals a record was kept by GPO of the name and address of the purchasing party, the date of sale, and the number of copies sold. No such records were kept by the resale agencies (GPO distribution centers, which are effectively retail bookstores, and college textbook distribution firms). To tap this part of the DOT user population, we surveyed a probability sample of the single-order purchasers of the DOT; in addition, we solicited information from casual samples of two types of known DOT users: those identified by staff of the State Occupational Information Coordinating Committee and those identified by researchers who had published material using the DOT.

In order to interpret responses from a probability sample of single-order purchasers of the DOT as being representative of the universe of DOT users outside federal agencies, it is necessary to make two assumptions: first, that purchasers of the DOT from resale agencies do not differ in the aggregate from those who purchased the DOT directly from the GPO; and second, that purchasers do not differ in the aggregate from nonpurchasers who use the DOT. The first assumption creates no difficulty; there is no reason to believe that the manner of purchase seriously affects the nature of use. The second assumption is somewhat more troubling. In many cases the purchasing party was an organization or division within an organization. In such a case many people may use a single copy of the DOT. As we note below, our sampling strategy was designed to elicit a response from the primary user of the DOT within an organization, but it was not tightly controlled and is hence subject to an unknown amount of error. Despite these problems we regard our coverage of various types of users of the DOT as fully adequate for our purpose, which was to ascertain the major uses made of the document.

Probability Survey of DOT Purchasers

To create a sampling frame for the survey of DOT purchasers, a list of names and addresses of persons who bought the DOT and other occupational analysis products still in print during the year period July 1977 through June 1978 was obtained from GPO. The earlier date was constrained by the lack of suitable records prior to July 1977, and the ending date of June 1978 was chosen so as to allow potential respondents a chance to become familiar with the item they purchased before being queried. With this sampling frame we were guaranteed both an address and an interest in occupational analysis products, as evidenced by the fact that the individual or organization had purchased an OA publication. Given the December 1977 publication date of the fourth edition DOT, the


DOT Distribution[a]
Department of Labor (~ 30,000 copies total)
ES state offices (24,100 total) proportional to size depending on the Resource Allocation Formula
10 DOL regional offices (300 total) 30 copies to each
OAFC (315 total) (10 offices and one special project)
Informal distribution (~ 6,000 copies)
Bureau of Apprenticeship and Training (ETA) (1,000 total)
Distribution to regional and state offices for field representatives
Social Security Administration (2,240 total) (Bureau of Hearings and Appeals—500 copies)
Remainder to Bureau of Disability Insurance
Department of Defense (1,250 total)
Department of the Navy
Veteran's Administration (520 total)
Distribution to 58 regional offices, proportional to size
GPO Sales
(201,394 copies printed for sale; 115,115 sold as of September 30, 1979)[b]
"Single-order" type orders
Bulk orders-[b] GPO distribution centers
Bulk orders-[b] college textbook orders

[a] In addition to print distribution, the DOT has been copied onto microfiche by the Congressional Information Service.

[b] Although up-to-date figures are not available, our best estimate is that approximately half the GPO sales are single orders and half are bulk orders.

FIGURE 4-1 Distribution of the fourth edition *Dictionary of Occupational Titles.*

use of this sampling base indicates that we sampled from among those persons who purchased this edition during its first 6 months of availability.

The potential respondent universe included 11,476 names. Names and addresses were selected from this list by random sampling with probability of selection proportionate to the number of copies purchased. A relatively small sample of purchasers ($N = 472$) was drawn on the grounds that a high return rate from a small sample would produce more accurate results than a low return rate from a large sample and that our resources were not sufficient to ensure a high return rate unless we started with a relatively small sample. Our strategy proved successful in that we ultimately achieved a 74 percent completion rate, which is very high for mail surveys.

The selection procedure entailed sending one questionnaire (shown in Appendix A) to each name and address selected regardless of how many copies were purchased. The questionnaire was sent to the listed address with instructions in the cover letter to forward the questionnaire to an appropriate individual, i.e., an actual user of the DOT. This instruction was necessary because the name of the purchaser provided on the GPO list was not necessarily the person for whom the publication was ordered; we had no control over which individual actually received the questionnaire.

Interviews, Case Studies, and a Survey of Institutional Users

Because the GPO list was limited to single-order purchasers, we supplemented the survey results by eliciting information from large institutional users of the DOT outside the Employment Service. This task was approached in two ways. First, the staff conducted interviews at organizations that are large users of OA products (mainly federal agencies in the Washington, D.C., area). In addition, detailed case studies of DOT use were conducted at the federal agencies that ordered large numbers of copies of the fourth edition DOT (see Figure 4-1): the Bureau of Apprenticeship and Training of the Employment and Training Administration, the Bureau of Disability Insurance of the Social Security Administration, and the Veterans Administration. (The Department of Navy never distributed its copies, so no case study was conducted there.) Interviews were generally conducted with the director and other members of the professional staff of the division in which DOT use was most prevalent (see Appendix B for detailed reports). Second, a copy of the purchaser questionnaire was sent to a list of 338 names generated by contacting the various state offices of the State Occupational Information Coordinating Committee (SOICC). The SOICC names were solicited to enlarge the number of responses from persons within various state organizations with particular knowledge of or interest in the use of the

DOT in their state or whose work might be seriously affected if the DOT were to be discontinued. Whereas the GPO sample was a probability sample of purchasers, the SOICC list had the very different purpose of getting the questionnaire to institutional users who might not be well represented on the purchaser list.

Survey of Researchers

A final group of users of the DOT outside the Employment Service is academic and other researchers. In order to identify this population a query was sent to a group of researchers who had used the DOT in their published or unpublished work as well as to those researchers who have discussed or criticized the DOT; the target population was identified informally on the basis of staff and committee knowledge. In addition, the staff contacted purchasers of the DOT who appeared on the GPO list with the title Dr. or Professor or who were located in a college or university academic department. A letter to researchers requested reprints or citations of published and unpublished work in which the DOT was used as a research tool. This material was used in the compilation of an annotated bibliography of research uses of the DOT (see Appendix C).

TIMETABLE OF SURVEY PROCEDURES

Preliminary versions of the questionnaire were reviewed by members of the committee and by members of the Department of Labor Technical Steering Committee (representatives from the departments of Labor, Commerce, and Health, Education, and Welfare). The questionnaire was revised, both in the wording and sequencing of questions, and a pretest version was sent to 50 randomly drawn names from the GPO mailing list on December 11, 1978. On January 5, 1979, a follow-up questionnaire was sent to those of the original 50 names who had not responded to the previous inquiry.

On January 9, 1979, a revised version of the questionnaire and a supporting statement were sent to the Department of Labor (DOL) so that DOL staff could initiate clearance procedures with the Office of Management and Budget (OMB). Clearance was granted from DOL on February 13 and from OMB on March 21. On the basis of the pretest results, minor revisions were made, and the final printed version of the questionnaire was sent to the sample of DOT purchasers and the SOICC group on April 13, 1979. Mail follow-ups to those who had not responded were sent out on May 8 and June 5. A final telephone follow-up of the DOT purchaser sample was conducted during the week of July 16–20; those respondents agreeing to fill out the questionnaire were sent another copy. As of August 15, 1979, 632 questionnaires had been returned, representing a 74-percent response rate for the DOT purchasers and an 84-percent response rate for the SOICC group.[1]

INSTITUTIONAL USES OF THE DOT: A SAMPLE OF PURCHASERS

The purchaser survey was designed to answer four basic questions: (1) who uses the DOT and for what reasons, (2) what is the nature and frequency of DOT use, (3) how essential is its use, and (4) how adequate is it for the purposes for which it is used? This section provides the results of the survey of those DOT purchasers who reported that they had ever used the DOT (90 percent of all the responding DOT purchasers).[2] Appendix A presents the response frequencies for each item in the questionnaire.

A wide variety of organizations find the DOT helpful in their work. Tables 4-1 and 4-2 provide information on the type of employer for which the DOT purchasers work and the type of work they do. Among the most frequent types of employers are educational institutions (42 percent), government agencies (20 percent), private for-profit companies (13 percent), libraries (13 percent), and nonprofit organizations (10 percent). Purchasers did a variety of types of work, the most prevalent being career and vocational counseling (30 percent), library reference (18 percent), management (15 percent), and employment placement (8 percent).

Table 4-3 provides an overall view of the type of work done by purchasers in various kinds of organizations. Users in educational institutions are employed primarily in career and vocational counseling and guidance. In the educational institutions surveyed, 57 percent of the DOT users do this type of work. Another 13 percent are engaged in

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[1] Twenty-six percent of the DOT purchaser sample did not respond. A few of these nonresponses were due to the respondent's being too busy to fill out the questionnaire. A few other respondents reported that they did not use the DOT and thus could not respond to the survey. However, the vast majority (96 percent) of nonrespondents never responded to any of the three mailings and could not be contacted by phone. It is reasonable therefore to infer that many of these questionnaires never reached their target owing, no doubt, in large part to the lack of specificity in the GPO list of purchasers, which often did not list an individual's name. This problem was particularly difficult given the number of large institutional purchasers of the DOT included in the sample.

[2] Because of the lack of specificity of the sampling frame (the GPO list of names and addresses), a question was included on the survey to identify Employment Service employees. Since the primary interest in this section is in exploring DOT use by agencies or organizations other than the Employment Service, the eight respondents who reported that they worked for their state Employment Service were excluded from the analysis. See chapter 3 for details on Employment Service use of the DOT.

TABLE 4-1 Distribution of DOT Purchasers, by Type of Employer ($N = 309$)

Type of Employer	Percentage
Library	13
Educational institution	42
Government	20
Private for-profit business	14
Nonprofit business	10
Other types of employers	2
TOTAL	101

vocational education. The DOT users in government agencies at the federal, state, and local levels, on the other hand, are engaged in a variety of different kinds of work, primarily rehabilitation counseling (mostly at the state level), employment placement and career counseling (mostly federal), and the projection of labor force trends (mostly county/local government). In contrast, users in private industry are employed quite differently: two thirds are in administration, including personnel or general management and compensation administration. The occupational identifications of DOT users are reflected in the professional associations to which the respon-

TABLE 4-2 Distribution of DOT Purchasers, by Type of Work ($N = 307$)[a]

Type of Work	Percentage
Career or vocational counseling	30
Rehabilitation counseling	7
Vocational education	7
Employment placement	8
Management/compensation	15
Projections/occupational information dissemination	7
Librarianship	18
Teaching/research	5
Other work	4
TOTAL	101

[a] Total N of 309, with two no answers.

dents belong; the most frequently mentioned associations include the American Personnel and Guidance Association, the American Vocational Association, the National Rehabilitation Association, and National Education Association.

HOW THE DOT IS USED

Given the nature of the sample (purchasers of the fourth edition DOT), it is not surprising that 88 percent of the respondents report that they have used the fourth edition. The bulk of respondents report that they make more frequent use of the fourth edition than of earlier editions. Of the fourth edition purchasers, 43 percent note that they use the fourth edition regularly, while another 45 percent report occasional use in the past year. At the time of the survey, some organizations were still making use of the first two volumes of the third edition: more than 46 percent of the sample report that they had used either the first or second volume of the third edition DOT in the past year (third edition Volumes 1 and 2 include the definitions of titles, the occupational classification, industry index, and the worker trait information). For those respondents dependent on worker trait information, a supplement of the third edition DOT (U.S. Department of Labor, 1966) is the only available source, since at the time of the survey the fourth edition worker trait data had not yet been published.

Table 4-4 presents a description of the use of the component parts of the DOT by purchasers engaged in various types of work. The DOT job titles and definitions are by far the most heavily used parts of the DOT: 95 percent of those responding report that they use the dictionary function of the DOT. Moreover, use of the job titles and definitions is heavy regardless of the type of work performed. Another frequently utilized part of the DOT is the classification scheme itself. Three fifths of the respondents indicate that they use the DOT classification and codes for administrative and statistical reporting reasons. The only groups not reporting heavy use of the DOT codes and classification are librarians and those engaged in management or compensation administration. The worker function data (the complexity of the relationship of the occupation to data, people, and things) or their rearrangement into the worker trait groups is used by an identifiable minority of the respondents. Not surprisingly, the types of work for which these parts of the DOT are most useful are those concerned with the transferability of skills, that is, in matching an individual to employment on the basis of his or her previous jobs and/or assessed skill level. Counselors (especially those in rehabilitative counseling) and educators (in the career counseling field) are among those most likely to employ the worker function scales. The industry designation and the

TABLE 4-3 Percentage Distribution of DOT Purchasers Engaged in Various Types of Work, by Type of Employer

	Type of Employer						
Type of Work	Library	Educational Institution	Government	Private For-Profit Business	Non-Profit Business	Other Types of Employers	Total
Career or vocational counseling	0	57	15	0	21	0	29
Rehabilitation counseling	0	2	15	7	17	38	7
Vocational education	0	13	5	2	0	12	7
Employment placement	0	2	18	7	24	12	8
Personnel management	0	2	7	48	9	0	9
Labor force projections	0	0	15	0	10	0	4
Occupational information development and dissemination	0	3	5	0	0	12	3
Compensation administration	0	1	3	14	3	0	3
General management/ administration	0	3	3	5	0	0	3
Teaching	0	9	0	0	0	0	4
Librarianship	100	6	5	5	7	0	18
Research	0	1	0	2	3	0	1
Other work	0	0	8	10	7	25	4
TOTAL	100	99	99	100	101	99	100
N[a]	(39)	(129)	(60)	(42)	(29)	(8)	(307)

[a] Total *N* of 309, with two no answers.

TABLE 4-4 Percentage of DOT Purchasers Using Component Parts of the DOT, by Type of Work

	Type of Work									
Component Part of DOT	Career or Vocational Counseling	Rehabilitation Counseling	Vocational Education	Employment Placement	Management/ Compensation	Projections/ Occupational Information Dissemination	Librarianship	Teaching/ Research	Other Work	All Types of Work
Job titles and definitions	94	91	100	88	100	95	93	100	100	95
Industrial designation arrangements	25	50	32	24	13	45	18	60	31	27
Occupational codes and/or classification	64	86	73	60	36	75	43	87	46	59
Worker trait groups	56	82	46	24	15	40	26	67	31	41
General educational development (GED)	33	73	14	28	17	50	17	53	15	30
Specific vocational preparation (SVP)	44	82	27	36	13	50	26	60	31	37
Interests, aptitudes, and temperaments	53	73	27	28	15	25	28	73	23	38
Environmental and physical working conditions	43	82	36	20	13	30	22	60	23	34
Worker function (DATA, PEOPLE, and THINGS specifications)	46	59	41	32	15	50	15	80	15	36
N[a]	(89)	(22)	(22)	(25)	(47)	(20)	(54)	(15)	(13)	(307)

[a] Total *N* of 309, with two no answers.

TABLE 4-5 Percentage of DOT Purchasers Who Would Experience Disruption of Work if DOT Were Discontinued, by Type of Work

Type of Work	Extent of Disruption No Effect	Minor Effect	Major Effect or Disrupt Work	Total	*N*
Career or vocational counseling	8	57	34	99	(87)
Rehabilitation counseling	18	32	50	100	(22)
Vocational education	4	46	50	100	(22)
Employment placement	17	38	46	101	(24)
Management/compensation	29	58	13	100	(45)
Projections/occupational information dissemination	21	21	58	100	(19)
Librarianship	4	69	27	100	(52)
Teaching/research	0	33	67	100	(15)
Other work	23	54	23	100	(13)
TOTAL[a]	13	52	36	101	(299)

[a] Total *N* of 309, with 10 no answers.

worker trait data (GED; SVP; interests, aptitudes, and temperaments; environmental and physical working conditions) are used by approximately one third of the respondents. As is true for the worker function scales, the worker trait data for specific occupations are heavily used by those assessing the transferability of skills. Perhaps the clearest example of this type of use is in the rehabilitation counseling field; counselors employ the entire range of worker trait information to guide their disabled clients in choosing appropriate alternative employment given their education, skill level, past employment, and disabilities. (For additional details on this type of DOT use, refer to Appendix B for reports from site visits to the Bureau of Disability Insurance and the Veterans Administration.)

HOW ESSENTIAL IS THE DOT?

From the information conveyed in Table 4-4 it is clear that those who purchased the fourth edition DOT do in fact use the various parts of the DOT in their work. Although certain parts are used more than others (e.g., job titles, job defintions, and the DOT codes), there is an identifiable subset of persons and organizations using every major part of the DOT. An important question is whether this information could be derived from alternative sources or whether the DOT is a unique source of occupational information, the lack of which would seriously hamper the ability of users to do their jobs.

Table 4-5 provides at least a partial answer to this question. The respondents were asked to estimate the extent to which their work would be disrupted if the *Dictionary of Occupational Titles* were to be discontinued. A total of 88 percent of the respondents report that discontinuing the DOT would have an effect on their normal work operations; 36 percent report that the inconvenience they would experience would be major or that discontinuance would seriously disrupt their work. The extent to which discontinuance of the DOT would affect operations varies somewhat by type of work. Well over three quarters of the respondents in all but one of the work categories indicate that losing the DOT would have at least some effect on their work. Some groups, however, indicate that they would experience greater inconvenience than others. More than half the respondents in four categories view the continuance of the DOT as essential to their ongoing operations (i.e., report that loss of the DOT would cause them major inconvenience or seriously disrupt their work): those employed in rehabilitation counseling, vocational education, labor force projections and occupational information dissemination, and teaching and research (educators in the counseling field). When asked whether substitute sources exist to which they could turn for the information they currently derive from the DOT, only about one fifth of the respondents in each of these four groups answered in the affirmative. Managers (personnel and general) and compensation administrators are least likely to report that the DOT is essential to their work. However, only 26 percent of these respondents knew of any alternative sources of occupational information they could use to provide the information they currently derive from the DOT. Career or vocational counselors and librarians are also less likely than respondents in other work categories to report that the DOT is essential to their work. However, respondents engaged in these types of work are somewhat more likely to know of other sources of occupational information; 58 percent of the counselors evidently feel that the DOT is only one of a variety of occupational sources they could use in their work.

To determine what kinds of occupational information other than that provided in the DOT are used, respondents were asked whether and how frequently they had used various occupational information publications in the past year. Table 4-6 presents the results of this question cross-classified by type of work. A majority of the respondents indicate that they make use of the wage surveys published by the Bureau of Labor Statistics (BLS) and of the Department of Labor's *Occupational Outlook Handbook*: 57 and 80 percent, respectively, report that they made use of these two publications within the past year. With two exceptions, more than three quarters of the respondents in each category report that they used the *Occupational Outlook Handbook* in their work in the past year. Only in management and compensation administration are respondents less likely to indicate that they use the *Occupational Outlook Handbook*; however, these respondents are more likely than others to indicate use of the BLS wage surveys.

The average respondent makes comparatively little use of other occupational publications. However, respondents in different job categories find the occupational publications differentially useful. Career or vocational counselors, for example, are more likely than other respondents to indicate that they use other occupational publications. They are, in fact, significant users of commercially produced occupational material (Holland classification publications such as *Professional Manual for the Self-Directed Search* (Holland, 1973b); *The Guidance Information System: GIS Guide* (Time Share Corporation, 1976); occupational and career exploration kits (Science Research Associates, 1979); *Chronicle Occupational Library* (Chronicle Guidance Publications, no date); and *Worker Trait Group Guide* (Appalachian Educational Laboratory, 1978)). These commercially published career aids are often heavily based on the DOT, repackaged so as to be more readily available to and usable by the counseling client population. Other groups making significant use of these publications include rehabilitation counselors and educators (in the career counseling field). Finally, significant proportions of librarians and others involved in the dissemination of occupational information also note the importance of publications of the Census Bureau in their work.

ADEQUACY OF THE DOT

From the previous sections it is clear that many agencies and organizations outside the Employment Service use the DOT for a variety of different purposes, that identifiable groups use every major part of the DOT, and that most of those who purchased the DOT would experience inconvenience, often major inconvenience, if it were to be discontinued. This section explores the perceived adequacy of the DOT from the point of view of the external users surveyed. In addition, respondents' suggestions as to how the DOT should be improved are presented. Table 4-7 provides a compilation of respondents' perceptions regarding the adequacy of the DOT. Respondents were asked to consider how adequate the DOT is, given the main purpose for which they use it. Nearly two thirds of the respondents report that the DOT was very adequate. Only respondents working in management and compensation administration are less enthusiastic about the adequacy of the DOT: approximately equal proportions of these respondents rated the DOT as very adequate and somewhat adequate. Only a very few respondents in each category rated the DOT as inadequate for their purposes.

The perceived adequacy of the DOT was also tabulated separately for users of each component of the DOT. Without exception, at least 60 percent of the users of each part view the DOT as very adequate. This enthusiastic response, of course, refers only to the perceptions of respondents and not to any technical assessment of the DOT product (see chapter 7 for a discussion of the technical adequacy of the DOT).

Although viewing the DOT as generally adequate for the purposes for which they use it, respondents do provide suggestions as to how it might be improved. Table 4-8 presents these suggestions. Responding to a prepared list of improvements derived from the pretest, the majority (54 percent) of respondents indicated that career ladders should be incorporated into the DOT. In referring specifically to the fourth edition DOT a substantial proportion of respondents, although not a majority, indicated that they would prefer a hard cover (like that of the third edition). In addition, most types of users strongly support inclusion of the worker trait

TABLE 4-6 Percentage of DOT Purchasers Who Use Other Occupational Information, by Type of Work[a]

Occupational Information Publication	Type of Work									
	Career or Vocational Counseling	Rehabilitation Counseling	Vocational Education	Employment Placement	Management/ Compensation	Projections/ Occupational Information Dissemination	Librarianship	Teaching/ Research	Other Work	All Types of Work
BLS wage surveys	61	59	41	60	74	60	43	73	38	57
Occupational Outlook Handbook (OOH)	97	86	91	72	43	75	93	93	46	80
International Standard Classification of Occupations (ISCO)	6	9	4	4	2	5	17	7	0	7
Office of Education classification	20	14	23	12	9	15	6	40	8	15
Standard Occupational Classification (SOC)	7	14	14	12	4	20	13	20	0	10

Census publications	25	23	27	32	32	55	52	40	8	33
Handbook of Occupational Keywords (HOOK)	6	0	9	8	4	5	6	7	8	6
Publications using Holland classification	57	23	23	16	2	25	4	60	15	27
Career guidance system (TimeShare)	29	27	18	8	6	10	8	33	0	17
Occupational and career exploration kits (SRA)	63	27	32	12	4	20	20	40	0	31
Occupational Library (Chronicle)	65	23	49	4	2	10	24	47	8	29
Worker Trait Group Guide (Appalachia)	21	14	0	4	2	5	2	13	0	9
N	(89)	(22)	(22)	(25)	(47)	(20)	(54)	(15)	(13)	(309)

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[a] Percentage using other occupational information defined as those reporting regular or occasional use of publication in the past year. Those not utilizing the specified publication include those who never use it, those who are not familiar with it, and those not responding to question.

TABLE 4-7 Percentage Distribution of Judgments of Adequacy of the DOT for Main Purpose

	Adequacy of DOT for Main Purpose				
Type of Work	Very Adequate	Somewhat Adequate	Inadequate	Total	*N*
Career or vocational counseling	62	34	3	99	(87)
Rehabilitation counseling	68	32	0	100	(22)
Vocational education	82	18	0	100	(22)
Employment placement	74	26	0	100	(23)
Management/ compensation	52	43	4	99	(46)
Projections/occupational information dissemination	68	32	0	100	(19)
Librarianship	66	32	2	100	(50)
Teaching/research	60	33	7	100	(15)
Other work	39	54	8	101	(13)
TOTAL[a]	63	34	3	100	(297)

[a] Total *N* of 309, with 12 no answers.

information, which at the time of the survey was not yet available in the fourth edition. Few respondents see a need for the incorporation of the *Standard Occupational Classification* (SOC) codes into the DOT: in only one work category (teaching/research) does the proportion of respondents desiring SOC inclusion exceed one fifth. (Of course, since the SOC was first published in 1977, there has not yet been much chance for potential users to become acquainted with it.)

Finally, in two open-ended questions included on the survey, respondents were asked (1) whether there were any occupations not currently included in the DOT that should be and (2) for any additional suggestions for improvements. Suggestions of new occupations to be included ranged from the specific (e.g., word processor operator, solar energy technician, bilingual secretary) to the more general (e.g., newly emerging occupations, paramedical occupations, military jobs, executive titles, energy occupations). Other suggestions for improvements included incorporation of the Office of Education codes, a better indexing system, and easier readability.

GOVERNMENT USES OF THE DOT

As we have noted, some important users of the DOT cannot be readily identified through any systematic sampling strategy. Because the sampling frame for the probability survey was limited to retail purchasers (the GPO single-order list), users who purchased large quantities of the DOT by riding the Employment Service requisition are not represented. To cover these users as well as other major institutional users, committee staff conducted a series of interviews at various federal agencies. In addition, a copy of the DOT questionnaire was sent to state-level users of OA materials. This section presents the interview and survey results identifying the nature and extent of use of the DOT in these agencies.

INTERVIEW RESULTS

A number of government agencies make wide-ranging use of the DOT and other materials produced by the Division of Occupational Analysis. Four major uses were identified: (1) employment training (e.g., the Bureau of Apprenticeship and Training), (2) disability determination (e.g., the Bureau of Disability Insurance of the Social Security Administration), (3) rehabilitation and employment counseling (e.g., the Veterans Administration), and (4) program planning, counseling, and curriculum development. Each of these major uses is described in turn. Following this presentation the use of the DOT by occasional users, such as the Department of Defense and the Office of Personnel Management (formerly the Civil Service Commission), is discussed.

EMPLOYMENT TRAINING AND PRODUCTION OF OCCUPATIONAL INFORMATION

Within the area of employment training, major users of the DOT and other materials produced by the Division of Occupational Analysis are of two types: those concerned with the management and coordination of training programs and those concerned with producing labor market information related to planning and managing training efforts. Most, if not all, of the federally funded employment training programs fall under the purview of the Department of Labor and make use of DOT occupational titles and codes at least for record-keeping and statistical reporting (e.g., for recording information on clients, training opportunities, and job placements). For example, occupational records maintained by the 60 Job Corps centers across the country routinely include DOT titles and codes. While there is no national requirement that the prime sponsors of the

TABLE 4-8 Percentage of DOT Purchasers Desiring Specified Improvement, by Type of Work

	Type of Work									
Suggested Improvement	Career or Vocational Guidance	Rehabilitation Counseling	Vocational Education	Employment Placement	Management/ Compensation	Projections/ Occupational Information Dissemination	Librarianship	Teaching/ Research	Other Work	All Types of Work
Use of hard cover[a]	32	64	32	36	34	35	46	53	31	38
Division in two volumes[a]	36	32	9	36	13	20	32	53	38	29
More frequent publication	32	50	23	20	23	25	33	53	23	31
Inclusion of career ladders	56	64	64	48	53	60	46	67	23	54
Inclusion of GED and SVP[a]	42	59	41	40	21	55	22	80	15	38
Inclusion of interests, aptitudes, and temperaments[a]	57	54	50	28	17	50	43	93	8	45
Inclusion of physical demands and working conditions[a]	43	64	32	28	26	35	41	73	23	39
Incorporation of *Standard Occupational Classification* (SOC) codes	11	18	0	16	19	15	6	27	15	13
N[b]	(89)	(22)	(22)	(25)	(47)	(20)	(54)	(15)	(13)	(307)

[a] Referring to fourth edition usage only.

[b] Total *N* of 309, with two no answers.

decentralized Comprehensive Employment and Training Act (CETA) program use the DOT coding structure for their reporting, many apparently do assign DOT codes to both participants and job openings. In addition to using DOT titles and codes for record-keeping purposes, trainers rely on the DOT and other occupational analysis products as basic sources of occupational information both in planning actual training programs and in counseling clients about occupational opportunities.

For example, the Bureau of Apprenticeship and Training (BAT) purchased 1,000 copies of the fourth edition DOT to distribute to its regional, state, and local offices. Because of the Bureau of Apprenticeship and Training's heavy use of the DOT, an in-depth analysis was conducted by committee staff (see Appendix B for a detailed synopsis of the BAT's use of the DOT). The Bureau of Apprenticeship and Training is in the business of reviewing and registering apprenticeship programs for skilled trade occupations. Its dependence on the DOT can be documented by the fact that no apprenticeship program can be registered for an occupation that has no existing DOT code. The use of the DOT in this context is in assessing whether a proposed apprenticeship program meets the standards of "apprenticeability" set by BAT, that is, whether the program ensures that apprentices receive at least 2,000 hours of on-the-job training.

Currently, BAT personnel are considering liberalizing their requirements by supplementing their use of SVP with other measures for assessing the apprenticeability of occupations. One of the methods being considered is using the sum of the worker function scales (the fourth, fifth, and sixth digits of the DOT code); another is employing the math, reasoning, and language subcomponents of the general education development (GED) scale. The BAT representatives consider these measures appropriate because of their strong positive correlation with SVP. There are reports that operators of other federally funded training programs (e.g., CETA and the Work Incentive Program) have used the DOT materials in a similar way. Apparently, the DOT worker function (DATA, PEOPLE, and THINGS) scores were summed to create a synthetic indicator of training times that was then used to determine permissible levels of government expenditures for many, if not most, contracts from the Employment and Training Administration for on-the-job training. It was assumed that occupations with a higher skill-complexity code sum, and therefore a lower level of skill, necessitated less training time than those with a lower sum. One result of this practice was to exclude some occupations from federally funded training programs on the ground that they were not complex enough to require formal training.

Use of the worker function scales in this manner violates the original intent of these scales. Accordingly, representatives from the Division of

Occupational Analysis have suggested that the worker function scales not be employed in this manner. Managers of training programs are instead encouraged to rely on the SVP and GED estimates in determining training time requirements, as provided in a supplement to the third edition (a fourth edition supplement is currently being prepared). An interim publication produced by the Division of Occupational Analysis for the Help Through Industry Retraining and Employment (HIRE) progam and used by BAT provides fourth edition SVP codes for each nine-digit DOT code.

The proliferation of federally funded employment training programs has resulted in a growing demand for labor market information of all types. The DOT is widely relied on by producers of labor market information as the source of the most basic occupational information. In partial response to the growing demand for information on occupations, efforts were undertaken to improve and expand sources of information available to those involved in career exploration, including actual job seekers. One such program, the Department of Labor's Career Information Systems (CIS) program, funded eight states to develop and extend computer-based systems for providing occupational information to persons in the process of career exploration and decision making, especially students and out-of-school youths. All CIS systems use DOT titles and codes. In addition, the DOT is a major source of occupational information for the CIS; many CIS occupational descriptions closely resemble DOT definitions. Finally, a major objective of the CIS is to provide structured access to occupational information in order to assist individuals in matching personal characteristics with occupational characteristics. The CIS information on occupational characteristics is based heavily on the worker trait and worker function information contained in the third edition DOT.

Planners and managers of employment training programs are also heavy consumers of occupational information. Within the Employment and Training Administration (ETA), the Division of Labor Market Information (LMI) coordinates and conducts program development for labor market research and analysis units in all 50 states. These units were not set up to generate raw data; rather, they focus on the analysis of labor market information largely generated by ETA programs, including the Employment Service. The localized labor market information they produce is used widely by CETA prime sponsors, school vocational education planners, and others involved at the state level with employment training and vocational preparation. The DOT is used by those involved in the LMI program primarily as a source of occupational descriptions.

Chief among the labor market information producers is the Bureau of Labor Statistics (BLS). A number of BLS endeavors make direct, frequent use of the DOT and other information generated by the Division of Occupational Analysis. A major BLS enterprise that relies on the DOT is the Occupational Employment Statistics (OES) program. The OES is a federal/state cooperative program conducted for ETA's Division of Labor Market Information by BLS. It has recently been re-funded to provide national estimates, the first since 1971. The OES program is designed to produce state and area data on current and projected occupational employment for use in planning education and training activities. Data on wage and salary employment by occupation are collected in periodic mail surveys of a sample of nonfarm establishments, conducted by state employment security agencies.

Approximately 2,000 occupations are selected, either because they are highly skilled occupations or because they are ones in which large numbers of people are employed. The questionnaire is heavily based on the DOT; employers are asked about employment by DOT occupational title (or composites of DOT occupations) and by definitions that are largely abbreviated DOT occupational descriptions. When the decision was originally made concerning occupations to be included in the survey, a determination of the skill level of various occupations was made on the basis of SVP and GED estimates from the third edition DOT. The first national report since 1971, on manufacturing establishments, is due to be published in 1980. One third of the economy will be surveyed each year: manufacturing in the first year and nonmanufacturing in the following 2 years. Occupational Employment Statistics personnel estimate that 250,000 establishments are surveyed in each round and that, in the 3-year period, 60 percent of the employees in the country will be covered.

In addition to the DOT the *Occupational Outlook Handbook*, which is published every 2 years by the BLS, is a basic source of occupational information used in the employment training counseling process. The *Occupational Outlook Handbook* is related to the DOT in several ways: in addition to using DOT codes, its occupational descriptions borrow heavily from DOT definitions. Serious consideration is apparently being given to tying the *Handbook* more closely to the worker trait information contained in the DOT because of an increasing tendency within the counseling profession to make matches on this basis.

Other BLS studies are also intended to expand the base of occupational information used in employment training. The ES-203 program was begun to study the characteristics of the insured unemployed. In states that require individuals who make claims for unemployment insurance to register with the Employment Service, claimants' previous occupations are assigned DOT codes by ES workers. Under the ES-203 program a sample of those claiming unemployment insurance is selected for which Employment

Service workers record limited data on selected demographic characteristics (e.g., age, sex, race, occupation, and industry of last job). Apparently, however, little analytical use has been made of these data.

Interestingly, the BLS Area Wage Survey Program makes only minimal use of the DOT except as a general reference. The program, which conducts occupational wage surveys, prefers to develop its own occupational classification structures and data, which are considered relevant for analyzing differences in wages but not necessarily for other purposes. These occupational structures are apparently not standardized but are developed for particular studies on the basis of information gathered from both industry and labor.

From time to time, special purpose BLS studies make use of information from the Division of Occupational Analysis program. Several years ago, for example, at the request of the BLS Office of Occupational Safety and Health Statistics, the occupational analysis program staff identified more than 5,000 occupations meeting BLS's criteria of hazard. Interestingly, the Department of Labor's Occupational Safety and Health Administration (OSHA) apparently makes little or no use of the DOT. In analyzing illnesses and injuries by occupation for the purpose of standardizing workers' compensation practices, for example, OSHA indicated that it relied on census-derived occupational information.

DISABILITY DETERMINATION

A second major use of the DOT is the determination of disability and eligibility for disability benefits. Disability determinations are made for a variety of reasons having to do with an individual's employability. They may concern an individual's entitlement to compensation, or they may assist in identifying suitable alternative employment for a disabled individual. In order to document the use made of the DOT in this context, committee staff visited the Bureau of Disability Insurance of the Social Security Administration (for a detailed report see Appendix B).

The office within the Bureau of Disability Insurance (BDI) that ordered 2,240 copies of the DOT is the Medical and Vocational Methods Branch, which is concerned with the formulation and dissemination of policy concerning the medical definition of disability. The determination of disability, and hence the eligibility for benefits under Title II of the Social Security Act, depends on establishing that disabilities are debilitating, in the sense that they keep one from being employed in the same or "similar" work as one has performed in the past. The Social Security Act's definition of disability mandates that a person's ability to perform alternative work, his or her "residual functional capacity," be evaluated before disability benefits can be awarded. The DOT is an important source document used in this evaluation, as is a supplement to the third edition DOT entitled *Selected Characteristics of Occupations (Physical Demands, Working Conditions, Training Times).*[3] These materials are used primarily in making an assessment of the kinds of employment the claimant can perform, given the disability incurred and his or her past employment. The underlying principle employed in the evaluation process is that if the disability is not incapacitating—because the physical, mental, and skill levels of the disabled individual are sufficient to meet the physical, mental, and skill demands of his or her previous employment—disability benefits are not allowed. If the individual cannot perform his or her past occupation, a determination is made as to whether there exist other jobs in the national economy that the disabled person could perform (i.e., work similar to previous employment but perhaps requiring a lesser amount of exertion). This determination of the transferability of skills between past and potential employment is made by referring to the information on worker trait groups, industry designation, physical demands, working conditions, and the GED and SVP training time specifications, all of which are employed to develop a vocational profile of the claimant. The worker function (DATA, PEOPLE, and THINGS) scales as well as the GED and SVP codes are used as rough measures of the skill level of an occupation. According to BDI practice, in order for an occupation to be recommended as alternative employment to a disabled client, it must not have a skill level higher than the client's previous occupation. A second set of characteristics taken into account in recommending alternative employment includes the physical demands and working conditions of the job. These characteristics of recommended jobs can be compared with the job profiles developed for the claimant's previous occupation in order to find matches at lower levels of exertion that the individual might be able to perform given his or her disabilities.

An increasing number of BDI disability decisions are being appealed to the Bureau of Hearings and Appeals of the Social Security Administration. The courts have insisted that the bureau document the transferability of skills between past and alternative recommended occupations for disabled clients, and Bureau of Hearings and Appeals personnel have long relied on the DOT for this purpose. The bureau currently has nearly 1,000 vocational experts on contract who testify in roughly 10,000 disability cases per month nationwide. Their testimony has been based almost exclusively on Volumes 1 and 2 of the third edition DOT as well as the third edition supplement.

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[3] The fourth edition supplement is scheduled for publication in 1980.

REHABILITATION AND EMPLOYMENT COUNSELING

A third major use of the DOT is the counseling and rehabilitating of disabled workers. The Veterans Administration (VA), a large-scale user of this type, purchased 520 copies of the fourth edition for distribution to its 58 regional offices. To assess use of the DOT by counselors and rehabilitation specialists, committee staff visited the Washington, D.C., regional office of the Counseling and Rehabilitation Section of the Division of Education and Rehabilitation Service (see Appendix B for a detailed report). The VA is responsible for implementing Title 38 of the U.S. Code—veterans' benefits. The counseling and rehabilitation staff has two major responsibilities: (1) overseeing awards of educational benefits to veterans (and war orphans or dependents of permanently disabled veterans) and (2) providing rehabilitative counseling and vocational training and making recommendations for payment of benefits to service-disabled veterans.

Disabled veterans must undergo counseling if they wish to take advantage of veterans' assistance benefits under Title 38; veterans who are not disabled are not required to undergo counseling but may choose to do so. Eligibility for vocational rehabilitation is based on determination by a counselor of what additional training the veteran needs in light of functional limitations resulting from service-related disabilities. That determination is made on the basis of a review of the veteran's educational background and disability. In the process of identifying suitable work for which the veteran might be trained, a range of occupational materials, including the DOT, is used.

In the VA counseling process the DOT descriptions and worker trait groups are relied on as sources of information on relationships among occupations and the transferability of skills. In addition to using the DOT code to identify occupational objectives, counselors also use the DOT for occupational exploration. The use of the DOT in this context is to define the tasks entailed in each occupation or job so that a client can determine which jobs are well suited to his or her constellation of skills, abilities, and interests. In identifying appropriate alternative employment for service-disabled veterans, counselors employ the physical and environmental attributes of occupations provided as part of the worker trait information in the third edition DOT. These attributes are used as a validation mechanism to ascertain whether a client will be able to perform a particular occupation, given service-related disabilities.

In addition to using the DOT and other products of the occupational analysis program in counseling and in occupational exploration with disabled veterans, the VA uses the DOT for statistical reporting. Information on veterans' employment objectives is recorded in terms of DOT titles and six-digit codes (the VA plans to switch to nine-digit codes shortly).

State vocational rehabilitation (VR) programs use the DOT and other sources of occupational information in much the same way as does the Veterans Administration rehabilitation program. Determinations of eligibility for vocational rehabilitation are based on two findings: that individuals have mental or physical disabilities that are substantial handicaps to their employability and that VR services can be expected to improve their future employability. The first determination is made by a physician or psychologist; the latter is made by a VR counselor. In the course of determining whether rehabilitation would increase the employability of a handicapped individual, VR counselors make substantial use of worker trait and worker function information from the DOT, especially that related to physical demands and GED estimates. In assisting an individual to develop employment objectives the DOT is relied on as an important counseling tool. As is the case in the VA rehabilitation program, VR counselors continue to use the third edition DOT while they await publication of fourth edition worker trait information.

Those involved in public disability compensation and/or rehabilitation programs argue that there is no source of sufficiently detailed occupational information other than the DOT for making determinations concerning the existence of suitable alternative occupations or for the development of employment objectives. Other agencies active in the field, such as the Railroad Retirement Board and administrators of state workers' compensation programs, for example, apparently use the DOT in much the same ways as have been discussed. These materials are probably also widely used by the private disability insurance industry and by private organizations involved in rehabilitation work. The rehabilitation services branch of Goodwill Industries, for example, reports that it makes frequent use of the DOT and other occupational information in the course of evaluating candidates for rehabilitation. Goodwill Industries has a 3-week evaluation program during which counselors assess the interests, potential, and skills of those referred to them for rehabilitation and training. During the vocational exploration process the DOT is used in much the same way as the VA and VR counselors use it, especially the worker trait information. Furthermore, one evaluator at Goodwill Industries indicated that the DOT served an additional purpose: the job descriptions are often found useful in helping clients to accept the reality that they can no longer perform the same functions or do the same work they were capable of prior to becoming disabled.

VOCATIONAL AND OCCUPATIONAL EDUCATION

A fourth major use of the DOT is by vocational educators. In the fields of vocational and occupational education, substantial use is made of occupational information, including the DOT and other products of the occupational analysis program. Broadly speaking, occupational information is used by vocational educators in program planning, counseling, and curriculum development and occasionally for record-keeping purposes.

Each state receiving federal assistance for its vocational education program is required to prepare an annual state plan, which includes an analysis of labor supply and demand, in order to justify planned vocational programs. While some supply and demand data are generated locally, state vocational education planners rely heavily on information from the Department of Labor. When planning becomes specific about the occupational objectives of vocational programs, DOT titles and codes appear frequently alongside Office of Education program codes.[4] As one individual noted, despite the use of OE program codes for vocational education, students are actually being prepared and trained for DOT occupations, and program planners and instructors must therefore rely heavily on the DOT to describe the occupations for which students are being prepared.

Guidance counselors in the vocational education field use a host of occupational information products. These include the *Occupational Outlook Handbook* of the Bureau of Labor Statistics, a wide range of guidance materials issued by commercial publishers, and materials produced by trade and professional associations as well as the DOT, the *Job Guide for Young Workers*, and other products of the occupational analysis program. Many of these sources of occupational information serve as references for the use of counselors themselves, while others, such as the *Job Guide for Young Workers* and sometimes the DOT, are apparently used directly by vocational education students in planning their own employment objectives.

The use of materials such as the DOT by counselors is apparently inspired, at least in part, by the content of counselor education. Counseling education programs generally include at least one course on occupational information that instructs student counselors how to use the DOT, the *Occupational Outlook Handbook*, and other related publications as sources of occupational information in the counseling process.

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[4] The Office of Education program codes are unique six-digit codes identifying instructional programs recognized by the Office of Education. These codes are linked to DOT titles and codes in the U.S. Office of Education (1969) publication *Vocational Education and Occupation* in order to provide a way of reporting the relationship between education and work and to relate educational supply to labor market demand.

Although most vocational curricula are actually developed at the state level, state departments of vocational education are usually grouped in regional consortia that are actively involved in developing priorities for curriculum development and in providing individual states with much of the technical and background information needed for curriculum development. The Vocational-Technical Consortium of States (V-TECS), associated with the Southern Association of Colleges and Schools, is probably the most active of these consortia. The V-TECS is involved in producing task analyses that serve as background for the development of curricula by the consortium's 17 member states. Although the job descriptions in the DOT serve as an important reference, V-TECS supplements them with its own, more detailed job analyses prepared according to the Air Force and Army instructional systems analysis technique, a form of task analysis. Once V-TECS has identified a list of tasks associated with a particular job, it surveys incumbent workers to verify that they actually perform all of these tasks and to determine how integral they are to a job. On the basis of this analytical background, instructional objectives are identified for use in actual curriculum development.

At the stage of actually designing a vocational education instructional program the GED and SVP estimates and other worker trait information of the DOT are apparently relied on heavily. The GED and SVP estimates are reported to be particularly useful in determining criteria for exiting from given vocational programs at the high school level and for entering training programs at the community college level.

The National Center for Educational Statistics (NCES) is currently involved in nationwide implementation of a vocational education data system (VEDS). The VEDS is viewed as a method for accounting for "vocational education inputs, processes, outputs, and outcomes." In connection with the development and implementation of VEDS, the Office of Education is restructuring *Handbook VI*, its system of instructional program codes (see footnote 4). Program taxonomy will be structured around the *Standard Occupational Classification* (SOC) system because NCES plans to switch over to use of the SOC at the two-digit level. The DOT will continue to be used indirectly in reporting, since the SOC is dependent on the DOT for occupational descriptions. Because occupational objectives will continue to be stated in terms of DOT titles, NCES anticipates routinely going from a nine-digit DOT code to a four-digit SOC code and then to a two-digit SOC code.

OTHER USERS OF THE DOT

In addition to the major users of the DOT described above, other agencies use it in various ways.

Department of Defense

Each of the military services (Army, Navy, Air Force, Marine Corps, and Coast Guard) has its own system for classifying its military employees, which they justify by reference to the uniqueness of many, if not most, military jobs. Until recently, each service also had its own vocational testing and placement programs. Civilian employees of the military services have always been a part of the civil service system.

The military has, however, occasionally used products of the occupational analysis program when concerned with the transferability between military and civilian occupations. For example, because of a statutory requirement to maintain up-to-date records on individuals who could possibly be mobilized, the various reserve personnel centers across the country maintain a data set on reservists. In order to keep track of whether reservists are acquiring new skills useful to the military in case of mobilization, information is routinely collected on the reservists' current occupations.

Several events appear to have caused the military services to become increasingly concerned with the interrelationship between military and civilian occupations. The advent of the all-volunteer army has resulted in a need for the military to "sell itself" in the recruitment process to a much greater extent than was previously necessary. As a result it has become necessary to demonstrate to potential recruits what their military career prospects might be and how military training and experience relate to civilian occupations that could be pursued after completion of military service. The difficulties encountered by returning Vietnam-era veterans in securing civilian employment also stimulated the military's concern with the transferability of military to civilian employment. Upon release from the military an individual is issued separation papers that include information on his or her military occupational history coded to the DOT in anticipation of the possibility that employment might be sought through an Employment Service office. The DOT is also apparently used regularly as a source of information on civilian employment as part of the "out-processing" counseling process.

A document used both by military recruiters and by counselors at separation centers is the *Military/Civilian Occupational Source Book* (U.S. Department of Defense, 1975), assembled in 1975 jointly by the Department of Defense Military Enlistment Processing Command agency (MEPCOM) and analysts from the Texas occupational analysis staff. Analysts trained military classifiers in the use of the DOT and also were involved in assigning DOT codes to military occupations. The *Source Book* was created to serve as a single reference document for information on the military's enlisted occupations and, where possible, to equate those occupations with civilian occupations identified in the DOT. In preparing the *Source Book* the Department of Defense formulated composite job statements for the five military services in those occupational areas in which commonality of job tasks existed. A second edition of the *Source Book* (U.S. Department of Defense, 1978) was prepared with the assistance of the Texas occupational analysis field center and released in January 1978 to coincide with the publication of the fourth edition DOT. For each military occupation the *Source Book* presents information on the military job title, the U.S. Office of Education career cluster to which it relates, the civilian (DOT) title, the nine-digit code that appears in the fourth edition DOT, a composite job statement, a qualifications summary, and information on related military service jobs.

Recently, some use has been made of the DOT in the military's personnel planning efforts. For example, the Department of the Navy is involved in projecting the number and types of civilian employees it will need in the near future. Although Navy civilian jobs are normally described with civil service titles and codes, projected slots are also being assigned DOT codes because of the current effort to relate the military's own needs to the outside labor market. The Bureau of Naval Personnel, which projects noncivilian manpower needs, is also apparently involved in an effort to relate military and civilian codes.

Office of Personnel Management

The Office of Personnel Management (OPM, formerly U.S. Civil Service Commission) classification structure is unrelated to the DOT scheme. In fact, the DOT does not include descriptions of occupations unique to the federal civil service. Despite an atmosphere of uncooperation between the OPM and the Department of Labor, occasional use is made of the DOT by the OPM to assess transferability between federal service and private industry jobs. For instance, the Personnel Research and Development Center of the OPM's Bureau of Policy and Standards uses the DOT as a cross-reference to compare federal and private industry jobs. Recently, the Bureau of Recruiting and Examining became involved in an effort to prepare model federal service occupational briefs intended for the use of OPM recruiters. The DOT was used in this project as a reference to assist in the identification and development of "common use" job titles and descriptions that would be understandable outside the context of the federal service.

Development of the Standard Occupational Classification

The DOT and the occupational analysis program on which it is based have played a crucial role in the development of the *Standard Occupational Classification* (SOC), a system now being implemented in a wide variety of federal agencies. The SOC was constructed under the aegis of the Office of Management and Budget and is now, like most standard classification systems used in the United States, under the jurisdiction of the Office of Federal Statistical Policy and Standards in the Department of Commerce. Its structure was developed by a number of technical work groups in which all of the major federal agencies concerned with occupational data were represented; the office's Interagency Occupational Classification Committee took the coordinating role in this effort.

Representatives of the Department of Labor and the Bureau of the Census were particularly active in the development of the SOC, and both agencies lent key staff to the effort to assist in implementing technical work group recommendations and to review occupational definitions contained in the SOC. The content of these definitions, however, is heavily dependent on the descriptions included in the DOT.

The Office of Federal Statistical Policy and Standards has not had, nor is there any indication that it will have in the future, a research staff whose efforts can be directed to gathering the information on work content that is essential to keeping occupational definitions up to date. In this situation the SOC must continue to rely on the contributions of other programs; the occupational analysis program is, in fact, the only comprehensive source of information available.

Bureau of the Census

The system used by the U.S. Bureau of the Census in classifying occupation returns in the Census of Population, the Current Population Survey, and other special surveys is substantially different from that found in the DOT. The alphabetical index used by the Census Bureau in its coding operation presents a listing of some 30,000 entries that have appeared on schedule returns, together with the census code for each, but includes no descriptive material. Bureau staff therefore consult occupational descriptions in the DOT as an aid in allocating schedule entries not included in the census alphabetical index listing. In the past they have also consulted staff of the Division of Occupational Analysis to ascertain the work content of new occupations.

STATE GOVERNMENT USERS: THE SOICC GROUP

To supplement the preceding discussion on institutional users, results from the survey of persons identified as DOT users by each State Occupational Information Coordinating Committee (SOICC) are discussed in this section to provide an indication of the use of the DOT by state-level agencies. The analysis is restricted to those who reported that they have ever used the DOT (89 percent of the respondents).[5] As in the analysis of the purchaser sample, we consider the types of organizations using the DOT and the purposes for which it is used, the nature and frequency of use, how essential the DOT is to the ongoing operation of the organization, and how adequate the DOT is for the purposes for which it is used. Appendix A provides frequency distributions on each variable for the SOICC group.

Our purpose in soliciting responses to the DOT use questionnaire from individuals identified by SOICC representatives was to increase the probability of discovering what use of the DOT is made by state agencies, a category not well represented in the probability sample. In the SOICC sample, 62 percent of the respondents outside the Employment Service are employed in other state government work. The only other types of organizations represented to any significant extent are county or local government agencies (8 percent) and educational institutions (23 percent). Table 4-9 provides an overview of the type of work performed by type of employer. As we learned from the DOT purchaser sample, the primary use made of the DOT in educational institutions is by career and vocational counselors; secondary use is by those in vocational education. Those in state government agencies using the DOT are in counseling and vocational education or are engaged in projecting labor force trends and disseminating occupational information.

Seventy-four percent of the respondents reported that they had used the fourth edition DOT within the past year: 36 percent reported regular use and 38 percent reported occasional use. On the survey date, some of the respondents were still making use of the third edition DOT; 62 percent reported at least occasional use of the third edition during the past year. This is not surprising, since at the time of the survey the supplement to the

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[5] Since the primary interest in this section is in exploring DOT use by agencies outside the Employment Service, 68 ES employees (representing 24 percent of the 283 respondents) were deleted from the analysis. When ES employees and those who reported that they did not use the DOT are deleted from the sample, the effective sample size is 186. Use of the DOT by the 68 ES respondents is explored in chapter 3.

TABLE 4-9 Percentage Distribution of Type of Work, by Type of Employer, SOICC Group

	Type of Employer				
Type of Work	Educational Institution	State Government	County/Local Government	Other Types of Employers	Total
Career, vocational, or rehabilitation counseling	49	20	20	0	26
Vocational education	18	32	0	27	26
Employment placement	0	4	40	27	8
Management/compensation	4	9	20	0	8
Projections/occupational information dissemination	9	24	20	18	20
Teaching/research	16	7	0	9	9
Other work	4	4	0	18	4
TOTAL	100	100	100	99	101
N	(45)	(115)	(15)	(11)	(186)

fourth edition containing worker trait data (especially useful for counseling work) had not yet been published.

Table 4-10 indicates the percentage of respondents using each part of the DOT, cross-classified by the type of work performed. As was true for the DOT purchaser sample, the state-level group uses the DOT especially for its dictionary capabilities and for administrative and statistical reporting reasons: 90 percent of the respondents indicated that they had used the job titles and definitions, and 80 percent reported that they had used the occupational codes in the past year. The use of these component parts of the DOT is high regardless of the type of work performed. Unlike the DOT purchaser sample a majority of respondents also reported using the specific vocational preparation (SVP) codes, the most common use being to estimate training times for on-the-job training contracts. Estimating the amount of training time required for a job is especially useful in counseling, vocational education, and work involving the dissemination of occupational information.

Eighty-seven percent of the SOICC group reported that discontinuance of the DOT would have an adverse effect on their work; 51 percent reported that discontinuance would seriously disrupt their work. Discontinuance of the DOT would particularly affect those involved in three types of work: counseling, employment placement, and projecting labor force trends and disseminating occupational information. Further evidence that the state-level users find the DOT essential to their work is that regardless of type of work performed, fewer than a third of the respondents know of substitute sources to which they could turn for the same kind of occupational information they currently derive from the DOT. Other kinds of occupational information found useful by the majority of the SOICC respondents include the BLS wage survey and the *Occupational Outlook Handbook*.

It is clear from the data presented above that a majority of these respondents view the DOT as being essential to their work. In addition, nearly 60 percent of the respondents perceive the DOT as being very adequate for the purposes for which they use it. With one exception (teaching and research) the majority of respondents in every category view the DOT as being very adequate. Only 3 percent of the SOICC respondents view the DOT as being inadequate for their purposes. Although a majority of respondents view the DOT as being adequate, there were suggestions as to how the fourth edition DOT could be improved. In particular, 54 percent indicated that career ladders should be incorporated into the next edition of the DOT. In addition, a significant minority indicated that further editions should be bound in hard cover and should include the full array of worker trait information.

TABLE 4-10 Percentage of SOICC Group Using Component Parts of the DOT, by Type of Work

	Type of Work							
Component Part of DOT	Career, Vocational, or Rehabilitation Counseling	Vocational Education	Employment Placement	Management/Compensation	Projections/Occupational Information Dissemination	Teaching/Research	Other Work	All Types of Work
Job titles and definitions	92	88	86	93	95	81	88	90
Industrial designation arrangements	29	15	36	33	43	50	25	31
Occupational codes and/or classification	73	83	79	80	84	88	75	80
Worker trait groups	62	35	29	53	54	31	25	46
General educational development (GED)	46	25	29	53	51	19	12	37
Specific vocational preparation (SVP)	62	50	43	60	62	25	12	52
Interests, aptitudes, and temperaments	54	38	14	40	43	31	12	40
Environmental and physical working conditions	54	23	21	47	49	25	12	38
Worker functions (DATA, PEOPLE, and THINGS specifications)	46	35	29	53	54	25	25	41
N	(48)	(48)	(14)	(15)	(37)	(16)	(8)	(186)

RESEARCH USES OF THE DOT

The *Dictionary of Occupational Titles* has attracted much attention from social scientists over the years. Sociologists, psychologists, and economists have found the DOT useful in a broad range of research activities. An annotated bibliography of research publications referencing the DOT (see Appendix C) describes specific uses of DOT information. More than 150 articles, papers, and books are cited in the bibliography, indicating that the DOT has been widely used as a research tool. The majority of these articles appear in academic journals and were located with the aid of the corporate section of the *Social Science Citation Index*, from which we were able to find citations for works published between 1969 and 1979. A survey of researchers and citations in articles already located supplemented the bibliography. These sources were especially helpful in identifying unpublished papers and books and articles published prior to 1969, which do not appear in the *Social Science Citation Index*.

This section describes the various research uses made of the DOT, considering the classification, titles and definitions, the worker functions, training time scales, and other worker traits. The section concludes with a review of evaluations of the DOT by academic researchers, and some problems encountered by social scientists who use the DOT for research purposes are also discussed.

It should be noted that almost all of the research literature reviewed here makes use of material from the third edition DOT. Since the fourth edition was not published until December 1977, almost no published research to date has been based on the fourth edition. This fact is particularly important when one is evaluating research purporting to show differences in the characteristics of jobs held mainly by men and those held mainly by women. There is strong reason to suspect that the third edition worker function scales undervalue jobs held mainly by women and that this bias was corrected in the fourth edition (see chapter 7). Hence substantive findings in this area based on the third edition should be treated with great caution.

CLASSIFICATION

Many researchers have used the DOT code for classification purposes. Frequently, the socioeconomic distribution of a sample is described in terms of the first digit of the DOT code (Schilling et al., 1977; Tinsley and Gaughan, 1975; Walls et al., 1977) or in a more general scheme of four classes (Lindholm and Touliatos, 1976; Lindholm et al., 1978; Seybolt and Gruenfeld, 1976; Touliatos et al., 1978).

To obtain a sample of occupations representative of the U.S. occupational structure, Tinsley and Weiss (1974) drew occupations from each of the first-digit DOT code groups in proportion to the number of workers in the United States employed in those groups. (The authors did not specify how they determined the distribution of workers in these groups.) The code was also used to determine job similarity in a study of the sources and benefits of workers' skills (Roomkin and Somers, 1974). Even social scientists far removed from occupational analysis and economics have found the DOT codes useful. For instance, clinical psychologists Brown and Pool (1974) matched brain-injured subjects with a control group on premorbid occupational level. However, they did not specifically define "occupational level."

JOB TITLES AND DEFINITIONS

The job titles and definitions provide researchers with a standard system for identifying and describing occupations. This information has been incorporated into several vocational guidance tools (e.g., the Vocational Card Sort (Cooper, 1976), the Non-Sexist Vocational Card Sort (Dewey, 1974), and the Occupational Reinforcer Patterns (Borgen et al., 1972)). In addition, Remenyi and Fraser (1977) examined the effects of occupational information on students' occupational perceptions by adding DOT definitions to the titles, and Sterne (1974) used the titles in a study of the validity of the Kuder Occupational Interest Inventory.

WORKER TRAITS AND WORKER FUNCTIONS

The worker trait data and worker function scales have received by far more attention in the research community than any other part of the DOT.

Data, People, and Things

The worker function scales, which measure a job's complexity in relation to data, people, and things, have been used in many capacities. Sociologists and economists have attempted to describe the distribution of these job characteristics in the U.S. labor market. For instance, Dubnoff (1978) found that a job's complexity is inversely related to the percentage of employees who are female, and Lucas (1974) reported that complexity in relation to people is negatively correlated with percentage of employees who are black. Brown (1975) examined the distribution by race and sex of workers who hold discretionary jobs, defined as those jobs with a data or things rating of less than 5 or with a people rating of less than 6.

In a study of the status of jobs held typically by men and by women, McLaughlin (1978) used a modified version of the worker function scales. Spenner (1977, 1980) included the worker functions among his variables in a series of studies on intergenerational occupational transmission. He found that complexity is a factor only in the father-son occupational relationship.

The worker functions have been useful in applied research as well. Using the worker function scales and training time to generate five orders of job similarity, Fine (1957) proposed an approach to the transferability of skills that would be useful in vocational counseling and in designing training programs. Hemmens et al. (1978) compared the job tasks and skills of social policy planners, coded according to the worker functions, with training received in professional schools and found serious discrepancies. Modified versions of the DOT worker function scales were also incorporated into Dumas and Muthard's (1971) job analysis method for health-related professions.

A number of studies adopted the concept of worker functions without the actual scales. Kohn and Schooler (1969) developed a measure of substantive complexity, closely modeled after the DOT measures, to study workers' values and orientations. In a later paper (Kohn and Schooler, 1973) on the relationship between occupational experience and psychological functioning, they used the DOT worker function scales as a source of external validation for their own index as well as for assessing the complexity of past jobs. Mortimer (1974, 1976), in her work on intergenerational occupational transmission patterns, used the DOT interest variables to determine the functional foci of work (that is, the complexity of a job's relationship to data, people, and things). Finally, Prediger (1976) used worker trait and worker function variables to create a two-dimensional map relating workers and jobs.

Training Time

The DOT's two training time scales, general educational development (GED) and specific vocational preparation (SVP), have proven to be important sources of information for the social scientist. In studying the educational and skill level structure of the U.S. labor market, both Kolstad (1977) and Dubnoff (1978) found that GED and SVP are negatively correlated with percentage of employees in each occupation who are female. Lucas's (1977) hedonic wage equations indicate that workers receive higher monetary as well as "psychic" wages for higher levels of GED and SVP. The SVP measure was used in a similar study of wage attainment by Stolzenberg (1975). Kalleberg and Hudis (1979) reported that for men in their late careers, SVP has a significant effect on wage increase in general, especially for those who did not change occupations or employers.

Prompted by Miller's (1971b) comparison of workers' educational attainment and the required GED of their occupations, which implies that many members of the labor market are overtrained, Kalleberg and Sorenson (1973) and Coburn (1975) studied the effects of discrepancies between training and requirements on job attitudes and health. Finally, GED was found to be positively correlated with the employment stability of male parolees and probationers (G. Gottfredson and D. Lipstein, 1975).

Other Worker Traits

The other worker traits have appeared in the literature most often in descriptions of labor force composition and as variables in economists' wage equations. Using DOT temperament 3 (supervision) and 4 (autonomy), Dubnoff (1978) found that the relative growth of women's employment is likely to be greatest in occupations in which supervison was high and least in occupations requiring worker autonomy. An earlier study revealed that negative working conditions and heavy physical demands are in general less common in jobs held by women but are almost as frequent for jobs held by black women as for those held by white men (Lucas, 1974). Lucas (1977) later reported that workers receive higher wages in compensation for repetitive routine (temperaments) and obnoxious physical environments (working conditions and physical demands). Hartog (1977) presented empirical support for his multicapability theory of income distribution using the DOT aptitude scales matched with census income data.

USE OF DOT CONCEPTS IN OTHER SCALES AND CLASSIFICATIONS

DOT concepts have been incorporated into a number of scales, inventories, and classification systems. The Minnesota Job Requirements Questionnaire (MJRQ) assesses each of the nine DOT worker aptitude requirements by five items. Occupational reinforcer patterns, which describe the stimulus conditions available in the work environment for the satisfaction of worker needs, are based on the combined Minnesota Job Description Questionnaire ratings of supervisors and/or employees. Occupational reinforcer patterns for 148 occupations are presented alphabetically by

DOT title (Borgen et al., 1972; Rosen et al., 1972). Bemis et al. (1973, 1974) developed a structure of 62 occupational ability patterns using the DOT aptitudes and the worker trait groups. Later, Dawis and Lofquist (1974, 1975) cross-classified the occupational ability patterns and the occupational reinforcer patterns, obtaining as a result psychologically homogeneous groups of occupations (taxons). They embedded the DOT's occupational groupings—worker traits and worker functions—in the scheme now known as the Minnesota Occupational Classification System (MOCS). The American College Testing Program Occupational Classification System (ACT-OCS) incorporates all occupations listed in the third edition DOT in a structure derived from analyses of the worker traits and worker functions (Prediger, 1976). Holland's six-category occupational classification, based on a theory of personality types, has often been subdivided on the basis of GED level (G. Gottfredson, 1977; G. Gottfredson et al., 1975; L. Gottfredson, 1978); Viernstein (1972) has developed two methods for translating DOT codes into Holland codes. In assessing the status of occupations, Caston (1978) replaced the Duncan socioeconomic index with the GED and SVP scales. The DOT has also been recommended as a tool in coding occupations and industries into the detailed 1970 census categories (Featherman et al., 1975; Temme, 1975) and the International Standard Classification of Occupations (Treiman, 1977).

Vocational psychologists have turned to the DOT in developing other counseling aids. The Vocational Card Sort (Cooper, 1976), the Non-Sexist Vocational Card Sort (Dewey, 1974) and the SPART inventory (Ekpo-Ufot, 1976) are several examples. Time Share Corporation's (1976) computer-based Guidance Information System makes available information from the DOT to aid clients in choosing appropriate occupational categories.

Finally, aspects of the DOT have been incorporated into a number of occupational classifications and occupational dictionaries developed elsewhere. We have already discussed the influence of the DOT on the Standard Occupational Classification (U.S. Department of Commerce, 1977). In addition, the DOT served as a model for the *International Standard Classification of Occupations* (International Labour Office, 1958, 1968). Two foreign occupational dictionaries are heavily influenced by the DOT: the Japanese dictionary of occupational titles is an almost verbatim translation of the second edition DOT, and the *Canadian Classification and Dictionary of Occupations 1971* (Canadian Minister of Manpower and Immigration, 1971) acknowledges the use of certain features of the American DOT. In fact, the Canadian *Dictionary* includes for each occupation a "qualifications profile" consisting of ratings of GED, SVP, aptitudes, interests, temperaments, and physical demands.

EVALUATION OF DOT DATA

Although the DOT has proven to be a valuable source of information for social science research, there are serious drawbacks that prevent even more widespread use. The incompatibility of the DOT classification with other classification systems and their accompanying social statistics seriously limits its use, since researchers are often interested in relating the worker trait and worker function scales to data collected on general population samples. For instance, until recently it has been difficult to relate the vast wealth of census data to the DOT scales. A number of projects have attempted to cross-code the two systems. The Spenner-Temme file (Spenner et al., 1980) makes available weighted estimates of 17 occupational characteristics for the 595 1970 Census occupation industry categories (see also Temme (1975)). These include 10 third edition DOT characteristics: DATA, PEOPLE, and THINGS; GED; SVP; and temperaments 1, 2, 3, 4, and 8.[6] Spenner is currently expanding the file to include 20 additional DOT characteristics. The methods used in generating these measures as well as some evidence on their reliability and validity are presented by Spenner (1980). Miller (1971a) describes work coding the April 1971 *Current Population Survey* with 1970 Census codes and third edition DOT codes (the actual coding was done by occupational analysis field center personnel) and discusses the advantages of being able to move from one system to another. Similarly, Broom et al. (no date, 1977) had the 1971 *Australian Census Classification of Occupations* (ACCO) coded with DOT DATA, PEOPLE, and THINGS scores in order to study new aspects of occupational mobility patterns. The DOT data would be of much greater use in social science research if steps were taken to make the DOT classification system compatible with other widely used occupational classifications. The newly developed *Standard Occupational Classification* (U.S. Department of Commerce, 1977) goes some way toward meeting this objective.

A second major drawback to the use of DOT data in research is the lack of reliability estimates for the worker trait and worker function scales. The development of these scales has been so poorly documented that researchers cannot be altogether confident about the validity of their results. Although a number of articles trace the history of the current DOT data (Fine, 1955, 1968b; Fine and Heinz, 1957, 1958; Scoville, 1965; Studdiford, 1951, 1953), they have been largely descriptive. Very little empirical evidence supporting the scales' reliablity and validity is available. Social scientists have been quick to point out this deficiency (Desmond and Weiss, 1973; Pratzner and Stump, 1977; Scoville, 1966; Walther, 1960; Witt and Naherny, 1975), which has undoubtedly discouraged more extensive use of these scales.

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[6] In Appendix F we offer similar estimates for eight fourth edition DOT occupational characteristics: DATA, PEOPLE, and THINGS; GED; SVP; STRENGTH; PHYSDEM (physical demands); and ENVIRON (environmental conditions). See the introduction to the appendix for additional details.

Several studies have attempted to remedy this deficiency. Sainty's (1974) validation of the third edition worker trait groups was performed by comparing its factor structure with the factor structure of a random sample of 800 of the 4,000 jobs used as the basis for the DOT. Fine (1957) found that four experienced occupational analysts were able to determine Minnesota Occupational Rating Scale values fairly reliably for 37 jobs from Functional Occupational Classification Project data (worker trait and work performed dimensions), and Broom et al. (1977) attempted to validate the worker function scales in terms of the worker traits required by different jobs in the DOT.

These studies, however, mark only the beginning of an effort needed to assess the reliability and validity of DOT data and scales. Chapter 7 describes these issues in greater detail and presents the committee's own reliability studies.

USE AND DISTRIBUTION OF OTHER OCCUPATIONAL ANALYSIS PRODUCTS

In addition to the *Dictionary of Occupational Titles* the Occupational Analysis Branch of the Division of Occupational Analysis publishes or distributes a series of career brochures and pamphlets. Some of these publications are initiated by the national office, while others are initiated locally, either by field center staff or by local Employment Service personnel in consultation with field center staff. The Job Search Branch of the Division of Occupational Analysis is also responsible for distributing brochures, news releases, and other labor market information directly to occupational information consumers (primarily local Employment Service offices). This section provides a brief description of how these publications are distributed and who uses them.

The committee approached the task of determining the use of occupational analysis products other than the DOT in three ways:

1. The Government Printing Office (GPO) was asked to provide a list of names and addresses of those persons who had purchased at least one copy of a publication of the Division of Occupational Analysis during the period July 1977 through June 1978. Estimates were then derived of the total number of requests and total number of copies purchased during this

period. In addition, estimates of the total number of publications printed were obtained from Department of Labor representatives.

2. As part of our probability survey of DOT purchasers and survey of state-level users, we asked respondents to indicate the frequency with which they use various other publications of the occupational analysis program.

3. During interviews at local Employment Service offices, ES personnel were asked about their knowledge and frequency of use of various OA publications.

OCCUPATIONAL ANALYSIS BRANCH

The Occupational Analysis Branch of the Division of Occupational Analysis publishes a series of career-related brochures and pamphlets. These products range from in-house publications, such as the *Handbook for Analyzing Jobs*, to career brochures, such as *Career Opportunities in the Telephone and Telegraph Industries*, *Occupations in Library Science*, and *Career Opportunities in the Trucking Industry*. (For a listing of OA publications, see Appendix D.) Although most of the national career publications still in print are available for sale through the Government Printing Office, the bulk of these brochures are distributed through local Employment Service offices, including model job information sites. This material is also distributed on a more informal basis by occupational analysts at the national office to various other government agencies and other organizations, including those that helped to produce the brochures. Occupational analysts, for example, worked with representatives from the Division of Associated Health Professions (Bureau of Health Resources Administration) and the National Health Council in developing the *Health Careers Guidebook* and with the Environmental Protection Agency in the development of the *Environmental Protection Careers Guidebook*; copies of the brochures were sent to these agencies. The Employment and Training Administration's office of information also distributes single copies of OA brochures to those who request them. On the basis of the results from the DOT purchaser sample and the survey of state-level users it appears that the biggest consumers of these publications (other than Employment Service personnel) are career and vocational counselors, career educators, rehabilitation counselors, and employment placement personnel. For example, the Job Corps national office recently began distributing copies of the Career Opportunities and Career Guidebook Series to all Job Corps centers, regional offices, and agencies.

The state-initiated brochures also receive their primary distribution through local Employment Service offices. In California, for example, publications relevant to Employment Service activities are automatically distributed to a mailing list of local offices in the federal region in which the field center is located. The field center distributes these publications free to anyone who requests a small number, most notably school vocational counselors or other personnel involved with career guidance.

JOB SEARCH BRANCH

The Job Search Branch within the Division of Occupational Analysis distributes labor market information in a variety of forms. Working with the Employment Service's job bank master file, personnel of the Job Search Branch produce and distribute four major job search products (see chapter 5). The Job Search Branch sends out 700 copies of the *Job Bank Openings Summary* in microfiche form each month. The consumers of this information include primarily Employment Service offices as well as CETA prime sponsors, state and federal agencies (e.g., the Bureau of Vocational Rehabilitation and the Veteran Administration), and CETA contractors. More than 400 copies of *Job Bank Frequently Listed Openings* (JOB-FLO), in either microfiche or hard copy and in either national or local format, are distributed monthly to the same kinds of organizations receiving *Job Bank Openings*. About 165,000 copies of *Occupations in Demand* are distributed monthly, primarily to Employment Service local offices but also to secondary and college-level guidance counselors and other job placement personnel. Finally, 70 sets of the *Labor Market Information Analytical Table Series* (LMI-ATS) are sent monthly to the research and analysis chiefs of the state LMI offices.

Table 4-11 presents the results of the surveys of the DOT purchaser and SOICC samples regarding use of other occupational analysis materials as well as information collected from the Department of Labor (on the total number of copies printed) and from the Government Printing Office (on the number of copies sold between July 1977 and June 1978). Since the primary distribution point for these publications is local Employment Service offices (see chapter 3 for details on Employment Service use of these products), it is not surprising that few of the large number of printed copies were purchased through GPO during the period reviewed. Of those publications still in print, only *Job Descriptions and Organizational Analysis for Hospitals*, published in 1971, is still in relatively high demand through GPO. *Career Opportunities in the Telephone and Telegraph Industries*, published recently, is also requested more often than the other publications. *Health Careers Guidebook*, the most recent update of which was published in 1979, is also a popular item, as indicated by the large number of copies printed for distribution. One reason for the low sales of

TABLE 4-11 Percentage Using Other Occupational Analysis (OA) Products[a]

OA Publication	DOT Purchasers	SOICC Group	Total Number Printed[b]	GPO Sales[c]
Career Opportunities in the Telephone and Telegraph Industries (1977)	8	14	20,000	357
Career Opportunities in the Trucking Industry (1978)	12	18	20,000	204
Handbook for Analyzing Jobs (1972)	15	25	7,500	–
Health Careers Guidebook (1973)	24	25	72,000	–
Job Descriptions and Organizational Analysis for Hospitals (1971)	11	21	15,000	560
Job Guide for Young Workers (1970)	13	19	40,000	–
Occupations in Electronic Computing Systems (1972)	9	15	25,000	138
Occupations in Library Science (1973)	9	10	20,000	75
Task Analysis Inventories (Series 1) (1973)	7	17	–	76
Job Bank Openings Summary (monthly)	17	29	–	–
Frequently Listed Openings (monthly)	19	31	–	–
Occupations in Demand (monthly)	28	37	–	–
Labor Market Information Analytical Table Series (monthly)	16	28	–	–
N	(309)	(186)		

[a] Users of other occupational analysis products are defined as those reporting frequent or occasional use of publication in the past year. Those not using the specified publication include those who never use it, those who are not familiar with it, and those not responding to the question.

[b] The total number printed are estimates made in consultation with Department of Labor representatives. Publications with no estimate are monthlies (see text for distribution figure) or the number is unknown.

[c] GPO sales are defined as number of copies of publication sold through the Government Printing Office during the year period July 1977 through June 1978. Publications with no estimates are out of print or unavailable through GPO.

some publications is that they are nearing the end of their run and are due to be revised.

The data in the first two columns of Table 4-11 indicate that small but identifiable subsets of the DOT purchasers and state-level users recognize and use these other occupational analysis products. The Job Search Branch monthlies are used more frequently than other publications, but *Occupations in Demand* is the only publication recognized and used by at least one third of the group of state-level users.

SUMMARY

Since its first publication as a job placement tool for the U.S. Employment Service, the *Dictionary of Occupational Titles* has been used for a wide variety of additional purposes by many individuals and organizations outside the Employment Service. This chapter describes these uses on the basis of data derived from three primary sources: (1) a probability survey of purchasers of the fourth edition DOT, (2) a series of interviews with personnel at federal agencies targeted as DOT users, supplemented by a survey of state-level DOT users, and (3) a survey of researchers and review of published and unpublished work using or criticizing the DOT.

The results from the probability survey of DOT purchasers suggest that a wide variety of organizations use the DOT in their work, especially educational institutions, government agencies, private for-profit companies, and nonprofit agencies. The DOT users in these organizations are engaged mainly in career and vocational counseling, library reference, rehabilitation counseling, personnel management, and employment placement.

The DOT is most heavily used for its dictionary function: 95 percent of the DOT purchasers report that they use the DOT's job titles and definitions. Another frequently used part of the DOT is the classification and code structure: three fifths of the purchasers report using the DOT codes primarily for administrative and statistical reporting reasons. Although certain parts of the DOT are used more than others, there is an identifiable subset of organizations using every major DOT component.

A total of 88 percent of the DOT purchasers, especially those in rehabilitation counseling, vocational education, labor force projections, and occupational information dissemination and educators in the counseling field, reported that discontinuing the DOT would adversely affect their work; 36 percent reported that the impact would be large or that discontinuance would seriously disrupt their work. Additionally, two thirds of the respondents reported that the DOT was very adequate for the purpose for which they use it. In offering suggestions as to how the DOT might be improved, a majority of the purchaser sample indicated that career ladders should be incorporated into future editions; a strong interest was also expressed in having future editions bound in hard cover.

Interviews with institutional users revealed four major institutional uses of the DOT: (1) Agencies such as the Bureau of Apprenticeship and Training use the DOT for employment training purposes. (2) Some agencies such as the Bureau of Disability Insurance of the Social Security Administration use the DOT for disability determination. (3) Other agencies such as the Veterans Administration use the DOT for rehabilitation and employment counseling. (4) Vocational educators use the DOT for program planning, counseling, and curriculum development. The results from the survey of state-level users corroborates these findings: the two primary uses are for counseling and vocational education. The state-level users make substantial use of the job titles, definitions, and codes (as do the respondents from the DOT purchaser sample); they also report frequent use of SVP estimates of training time.

The DOT has also been used by sociologists, psychologists, and economists in a broad range of research activities. The DOT code is frequently used to describe the socioeconomic distribution of subject samples and to match experimental groups with control groups on occupational class and skill level. The worker traits and worker functions have been used in many capacities, most notably in describing the distribution of job characteristics across various sectors of the labor force and in examining shifts in labor force composition. Economists often turn to these scales when studying the determinants of wages, and psychologists use this information in studying the relationship between occupational characteristics and psychological functioning as well as effects on performance. In addition, the DOT has been a valuable resource in the more applied areas of vocational psychology and counseling. A number of new scales, inventories, and classification systems have also incorporated DOT data and scales.

Although the *Dictionary of Occupational Titles* has become useful in many organizations and agencies outside the Employment Service, there is no firm evidence that the other products of the occupational analysis program have reached a similarly large audience. Although the monthly job information summaries are widely distributed within the Employment Service, they are used by a relatively small number of outside users. Career brochures are not widely used either inside or outside the Employment Service, yet each of these publications is used by an identifiable minority of each of the user samples.

5 Organization of the Occupational Analysis Program of the U.S. Employment Service

INTRODUCTION

The *Dictionary of Occupational Titles* is produced by the Division of Occupational Analysis of the U.S. Employment Service, in Washington, D.C., in conjunction with 11 field centers located around the country. Job analysts working in the field centers collect the bulk of the data on which the DOT is based by visiting business establishments, observing workers in jobs, and recording and scaling the information observed. There are currently 129 professional and support positions in the field centers and 15 in the national office. It is estimated that production of the DOT occupies approximately 80 percent of total staff time (Booz, Allen & Hamilton, Inc., 1979: Vol. 1:I-2). In the 13 years preceding the publication of the fourth edition DOT, job analysts in the field centers produced more than 75,000 job analysis schedules for use in preparing the 12,099 occupational definitions included in the fourth edition.[1]

In addition to the actual production of the DOT the Division of Occupational Analysis is responsible for several other tasks: conducting training in the use of the DOT, providing technical assistance to parties interested in conducting job analyses, and conducting research and other development projects aimed at improving the job analysis and classification techniques used in the DOT. The division also produces two types of self-help informational guides. Career guides and brochures are designed to provide workers and labor market entrants with information about specific occupations. Job search materials are designed to aid workers in using the resources of local Employment Service offices to find jobs on their own (see Appendix D for a list of the publications of the division). In 1976 the division was assigned the responsibility for updating keywords, the descriptors being used by the Employment Service to develop automated procedures for matching workers and jobs.

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[1] While the fourth edition DOT (1977) states that 75,000 job analysis schedules were used in compiling the DOT, Booz, Allen & Hamilton, Inc. (1979: Exhibit IV-5) reports that 53,000 were used.

The division's Occupational Analysis Branch, which is responsible for producing the DOT, uses the decentralized framework of the Employment Service in the funding and operation of its 11 field centers. By means of contracts with the Employment Service agencies of the 11 states in which the field centers are located, the Division of Occupational Analysis provides funding and technical direction to the field centers for the express purpose of collecting the data used in the DOT and carrying out other functions of the Occupational Analysis Branch. The state Employment Service agencies administer the funds and staff the field centers.

The Job Search Branch, the division's only other branch, has little connection with the Occupational Analysis Branch and its associated field centers. The Job Search Branch bases its materials related to job search techniques on information that is generated by the ongoing operation of the Employment Service rather than that generated in the course of producing the DOT. It was formally incorporated into the Division of Occupational Analysis in 1976 when its previous parent organization, the Division of Labor Market Information, was moved out of the Employment Service and into another division of the Employment and Training Administration (the Office of Policy Evaluation and Research).

The Division of Occupational Analysis, including its field operations, is the subject of a recent report by Booz, Allen & Hamilton, Inc. (1979). The report focuses on the management and operations of the occupational analysis program and includes consideration of cost effectiveness, productivity, and administration. The reader is referred to that report for more detail on those aspects of the occupational analysis program. In introducing the report, Booz, Allen & Hamilton notes that the Division of Occupational Analysis has had administrative difficulties for some time. The division had five directors or acting directors in the 3-year period from 1975 to 1978, and the production of the fourth edition DOT suffered much delay, requiring 13 years and substantial intervention by the division's parent office, the Office of Technical Support. Moreover, the staff of the division's national office has declined from 33 in 1966, all of whom worked on DOT-related activities, to 15 in 1978, 4.5 of whom are in the Job Search Branch and have no connection with the production of the DOT (Booz, Allen & Hamilton, Inc., 1979:I-2, V-9). Thus the national office has only 10.5 staff positions authorized for its Occupational Analysis Branch, only 7.5 of which are professional positions, to oversee and direct the operations of 11 field centers, to produce and update a complex document, and to conduct needed research and other related activities.

This chapter reviews the organization and activities of the two units of the Division of Occupational Analysis, the Occupational Analysis Branch and the Job Search Branch, and of the 11 occupational analysis field centers. The chapter concludes with a discussion of the implications of the organization of the program for the production of the DOT.

THE OCCUPATIONAL ANALYSIS BRANCH

The functions of the Occupational Analysis Branch are formally defined (U.S. Department of Labor, 1976b); it (1) plans and develops systems for the collection, evaluation, and utilization of occupational analysis data on a local, state, and national basis, (2) prepares, maintains and disseminates current occupational analysis materials such as the *Dictionary of Occupational Titles*, occupational classification systems and techniques, job analysis techniques, and occupational brochures, (3) coordinates a network of field centers that conduct research and demonstrations of research results and provides training and technical assistance in occupational analysis, (4) provides technical assistance to state Employment Service agencies on occupational analysis matters such as experimental and demonstration projects concerned with the application and use of occupational analysis techniques, (5) plans and conducts occupational analysis studies for determining skill criticality and for developing basic occupational data to assist in alleviating employment problems in such critical areas as health and environmental control personnel, and (6) provides technical advice and assistance to other countries and other government agencies on occupational analysis.

As the Booz, Allen & Hamilton report notes, this group of statements does not clearly convey the overriding importance of the *Dictionary of Occupational Titles* in the functioning of the Occupational Analysis Branch. The data collection performed by the field centers, which requires the vast preponderance of their resources, is not even mentioned. Booz, Allen & Hamilton also notes that the statements fail to relate the activity of the Division of Occupational Analysis to the principal mission of the U.S. Employment Service, which is to help workers find jobs. In our judgment, while the lack of clear statements of mission and functions may have some importance for the program difficulties that have occurred in recent years, probably more important is the gradual diminution of the national office staff (both cause and symptom of low morale), the turnover in the directorship (again, both cause and symptom of low morale), and the cumbersome administrative arrangement between the national office and the 11 field centers.

The division's national office is charged with the responsibility of directing the technical aspects of the work of 11 field centers, each of which is administratively responsible to its parent state agency and subject to its regulations. As represented in Figure 5-1, the formal chain of command between the national office staff and the field centers is very indirect: from the Occupational Analysis Branch of the Division of Occupational Analysis through the Office of Technical Support to the U.S. Employment Service, then to the Office of Field Operations of the Employment and Training Administration, down through its regional offices and area operational offices, to the state Employment Service agency, usually through its technical services group, and finally to the occupational analysis field center.

The technical oversight function of the national office has many aspects. First, the national office assigns the particular industries to be covered by each field center (see chapter 6). Second, the national office provides guidelines, directives, and manuals to the staff of the 11 field centers to facilitate the basic data collection. It is important that the procedures used in each field center be identical, since the data are collated to form the basis of one product, the *Dictionary of Occupational Titles*. The national office also is responsible for such related activities as promulgating standards of quality control, conducting research to improve methods of data collection, updating the methodology used by the field center staff in their data collection work (e.g., the *Handbook for Analyzing Jobs*), and preparing guidelines for the production of the occupational definitions that are the basis of the DOT (e.g., the *Definition Writer's Handbook*).

In addition to oversight of field center activities the national office also plans the actual production of the DOT document, oversees its execution, plans for its distribution, and trains various constituencies in its use. The Occupational Analysis Branch is also responsible for the production of career guides and brochures that are based on information collected in the process of DOT production and for updating and maintaining the keyword descriptors.

The Occupational Analysis Branch, with only 10.5 staff positions, necessarily delegates much of its work to the field centers. For example, the New York field center has been delegated the lead authority in a new

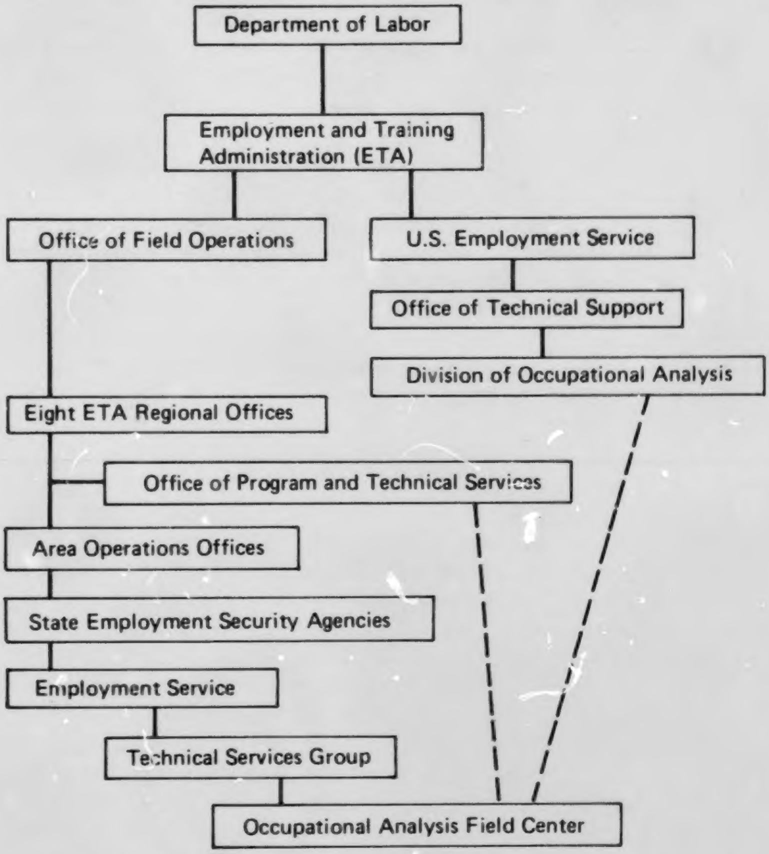
Department of Labor
Employment and Training Administration (ETA)
Office of Field Operations
U.S. Employment Service
Office of Technical Support
Division of Occupational Analysis
Eight ETA Regional Offices
Office of Program and Technical Services
Area Operations Offices
State Employment Security Agencies
Employment Service
Technical Services Group
Occupational Analysis Field Center

FIGURE 5-1 Organizational structure of the occupational analysis program. Source: Booz, Allen & Hamilton, Inc. (1979: Exhibits II-1 and III-5).

revision of the *Handbook for Analyzing Jobs*, the manual used by field staff as a guide to data collection procedures. Field center staff participate in the preparation of career guides and serve on various committees having to do with keywords. Although the national office delegates tasks to field centers, it does not appear to have succeeded in establishing effective control over the activities of the field centers. Our visits to the field centers indicate that there has been substantial confusion among the staff as to their role since the publication of the fourth edition DOT. The development of keywords and the fact that the Division of Occupational Analysis has been the object of study (both by Booz, Allen & Hamilton, Inc. and by this committee) appear to have created uncertainty within the field centers as to the usefulness of continuing with job analysis activities for production of a fifth edition. While some centers are continuing with the basic data collection as usual, others are not. Although some field centers are involved in other activities under the direction of the national office (for example, the new revision of the *Handbook for Analyzing Jobs*), it appears that on the whole the national office is not effectively directing the activities of the field centers.

Our visit to the North Carolina center, in particular, confirmed the lack of effective control of the various field centers by the national office, especially with respect to the standardization of data collection activities. The staff at the North Carolina center are in a unique position to observe the work of the other centers, since North Carolina is the repository for all the data collected for the fourth edition DOT. In the course of work on the fourth edition they found that the field centers contributed widely varying numbers of job analysis schedules in widely varying conditions of completeness and quality. Since the clerical staff in the North Carolina center enter many of the data into an automated information storage and retrieval system, they are aware, too, of difficulties in the actual production of the DOT caused by the wide variation in the quality and comprehensiveness of the source data.

Concerned with the quality of the upcoming fifth edition and with the lack of leadership emanating from the national office, the supervisor of the Utah center, with the cooperation of supervisors of other field centers, established a coordinating committee to work with the national office in setting standards and establishing procedures for data collection. At the present time, whatever coordination and direction of field center activities is occurring appears to be primarily the result of this coordinating committee.

Additional detail on the operation of the field centers is provided in a later section.

THE JOB SEARCH BRANCH

In addition to the Occupational Analysis Branch the Division of Occupational Analysis also houses the Job Search Branch. While the former unit is involved primarily with the production of the *Dictionary of Occupational Titles*, the latter is organized primarily around the production and distribution of labor market information derived from the Employment Service master data files. Since its formal incorporation into the Division of Occupational Analysis in 1976, the Job Search Branch has operated almost entirely independently of the Occupational Analysis Branch, in the sense that it has little if any input into the production of the DOT and virtually no contact with the field centers.

The Job Search Branch has 4.5 authorized staff positions, 3.5 of which are professional positions. The Job Search Branch personnel play a more specialized role in the job-matching process than does the staff of the Occupational Analysis Branch, providing various publications designed to encourage applicant self-service and placement at local Employment Service offices.

The formal functions of the Job Search Branch are defined below (U.S. Department of Labor, 1976b); it (1) develops and maintains a clearinghouse for occupational analysis information and related data for use by state agencies and the private sector involved with Employment Service programs, (2) designs, maintains, and monitors through channels a system for the development and utilization of job search materials for use by appropriate state ES components in assisting job seekers, (3) develops and disseminates handbooks, guidelines, techniques and prototype job search materials for use by state ES components in assisting job applicants in their search for employment, (4) develops model approaches for the assembly of job information needed by employers to meet the requirements of affirmative action and other programs and develops required technical job information and analyses as a basis for program planning and goal setting within the U.S. Employment Service, and (5) participates in and keeps informed on evaluation and operating reports provided by the Office of Program Review or other sources and recommends appropriate program modifications.

One major activity of the Job Search Branch is to oversee the model job information service (JIS) sites, set up in each of the federal regions to generate additional job placements. Full-service JIS sites have been set up in 10 cities, although approximately 1,000 local offices incorporate some parts of the JIS system. The job information service sites are separate sections within local Employment Service offices where job seekers can obtain both specific and general information on a self-service basis. The Employment Service has indicated that the establishment of JIS sites is based on the premise that most job seekers are capable of finding jobs with minimum assistance. Furniture and job search materials and displays in these units are arranged so as to enhance the dissemination of occupational information to those job seekers who already know the kinds of information they want. A library of job search materials, career brochures, and videotapes is provided for those seeking occupational information.

The Job Search Branch is also a major producer of the labor market information displayed at the job information service sites. There are four major products of the Job Search Branch, all derived from the Employment Service's own data files. (The use of these products by the Employment Service is discussed in chapter 3.) The *Job Bank Openings Summary* (JBOS) is a monthly publication, in tabular or microfiche format, that provides local and national summary job opening data on 800 permanent, full-time occupations. The *Job Bank Frequently Listed Openings* (JOB-FLO) is a monthly publication, available in hard copy or microfiche format, that provides area and national summary estimates on 385 full-time, permanent occupations in demand. Occupations and industries in heavy demand are identified, and in addition, education and experience requirements are specified. In the national summary, geographical areas experiencing heavy demand in particular occupations are listed by occupation. *Occupations in Demand* (OID) is a bulletin that identifies the 130 occupations most in demand throughout the national job bank system. The OID bulletin also notes where selected occupations are in demand and furnishes national summary data on the number of openings available and the specified average pay for selected occupations. Finally, the *Labor Market Information Analytical Table Series* (LMI-ATS) is also a monthly publication of statistical tables, available in printout or microfiche form. Analytical summaries are provided of job openings data for the nation, states, and job bank districts by occupational category, wage rate interval, and industry.

THE OCCUPATIONAL ANALYSIS FIELD CENTERS

At present there are 10 occupational analysis field centers and one special project, which receive technical direction from the Occupational Analysis Branch of the national office but have their funds administered by the state in which they are located. The primary function of these geographically dispersed field centers is to provide the raw data used in developing the *Dictionary of Occupational Titles.* In order to assess how adequately the field centers accomplish this purpose and the other more specialized functions they have undertaken at either local or national office initiative, members of the committee and staff visited 7 of the 11 centers, those located in New York, New York; Detroit, Michigan; St. Louis, Missouri; Raleigh, North Carolina; Los Angeles, California; Phoenix, Arizona; and Austin, Texas. Additional details on the structure, staffing, and cost effectiveness of each of the 10 centers and the special project can be obtained from the short-term management study conducted by Booz, Allen & Hamilton, Inc. (1979: Vol. 2).

OVERVIEW: ORGANIZATION

As noted above, the Occupational Analysis Branch is charged with coordinating and monitoring field center operations. Our site visits to the field centers have led us to conclude that the national office has not adequately carried out its leadership role. The field center supervisors and analysts we talked with uniformly expressed a negative perception of the leadership of the national office. Field center personnel continually conveyed to us their feeling that the national office staff lacked a sense of direction and failed to maintain its leadership role adequately in coordinating the work of the field centers. The supervisors also believe that the coordinating committee they organized to provide field input into the decision-making process has been helpful. Four of the field center supervisors, those from New York, California, North Carolina, and Utah, were elected to represent all the supervisors on this committee. The participants consider the role of this committee one of planning and recommending actions to the national office staff—not providing leadership, which they see as the prerogative of the national office.

An additional organizational problem faced by the field center personnel is that although they receive technical guidance from the national staff, they are employees of the particular state in which they are located and are thus subject to the personnel and compensation practices of that state. This arrangement has both negative and positive implications.

On the negative side are the following: The occupational analysis program is small in relation to the others being administered in that way (CETA and unemployment insurance), and its funding needs are often neglected. The national office lacks effective control, not only because the chain of communication is long and cumbersome but also because the field centers have two bosses. Although the money for their operation is provided by the national office through grants to the states involved, the field offices are in fact directly answerable to their state Employment Service agencies. The state agencies have direct command over the field centers and their resources and can and do request the help of the field centers for state projects. Some of the field centers devote substantial amounts of their resources to projects initiated at the request of their state agencies. Some field centers in fact resist directives from the national office.

In addition, since the state agencies staff the field centers, most of the employees of the field centers come from the state Employment Service, usually from various local Employment Service offices. As members of the various state civil services, field center staff have no direct promotional route to the national office, where their knowledge of field operations might be useful, and few promotional opportunities in the state service, since they are in fact most skilled in producing a national product. Thus these employees cannot be effectively rewarded or penalized by the national office, and there is little opportunity for communication between the national office and the field center staff that is based on informally established networks. Because of this cumbersome arrangement, most of the field staff seem to feel a remoteness from the national office that is inappropriate given their joint work on a national product. The field staff, like the national office staff, suffer from low morale.

Moreover, as we have noted, the state structures in which the field offices are embedded do occasionally hamper the operations of the field offices in staffing or in the completion of their tasks of occupational analysis. One example is the limitation some states have placed on out-of-state travel; an analyst might not be able to travel to another state to observe a job that he or she cannot locate within the state. The hiring freeze in California has affected that state's field center. Some states do not assign grade levels to lead job analysts that allow them to supervise other job analysts. States also require varying qualifications for the position of job analyst; in some states the job analyst is an entry-level position, whereas in others it is a more senior position. Given this structure, it is difficult for the national office to enforce uniform training or uniform performance standards among the analysts from the different centers. While the field center coordinating committee has been helpful in increasing the uniformity of procedures, it cannot solve the problem of lack of effective leadership completely. Since no field office has a real basis for authority over any other field office, only the national office, if it had effective sanctions, could be expected to exercise the leadership required to produce uniform materials in a decentralized system.

Some analysts, by contrast, find the organizational arrangement of the field centers more of a help than a hindrance. They feel that this arrangement enables them to work closely with state Employment Service personnel and keep them informed as to current occupational analysis activities. In turn, they are responsive to Employment Service suggestions regarding production of state-level career brochures and pamphlets. In return, the analysts are able to take advantage of already established Employment Service contacts at local firms, an important consideration for the field center staff given the difficulty of convincing employers of the relevance of job analysis to their own operations (see discussion in chapter 6). The state relationship was also felt to be beneficial in another sense. Given employer experience with recent federal inspection teams (especially from the Occupational Safety and Health Administration), many analysts fear that their connection with the federal government may hurt rather than help them gain access to employment sites.

STAFFING AND ORGANIZATION OF WORK

There are currently 129 full-time staff positions in the field centers; the number in each center ranges from 2 in the Arizona special project to 23 at the North Carolina center (Booz, Allen & Hamilton, Inc., 1979: Exhibit III-4). At the centers we visited, the staff consists of a manager or supervisor who coordinates the work of the staff, analysts who perform the actual on-site job analysis or work on special projects, and a clerical support group.

In California, two CETA trainees are also working at the field center as apprentice job analysts. Although these trainees are assigned to work full-time at the center, they are paid from CETA funds. They receive the full training that all new occupational analysts receive and are encouraged to view the job as a stepping stone into permanent employment if vacancies occur.

Work is generally organized by dividing the analysts into two or three working groups, each supervised by a lead, or senior, analyst. The division into work groups does not necessarily correspond to substantive distinctions. For example, the New York center has two groups, with six occupational analysts in each. Historically, these groups had separate areas of emphasis; currently, however, there are no professed distinctions between them. Analysts in both groups are supervised by a senior analyst and work on ongoing studies of business establishments as well as on more specialized projects initiated either locally or by the national office.

The situation is similar in California, where there are two groups of analysts, each informally led by a "functional lead analyst." One unit is devoted to ongoing studies of business establishments, while the more experienced analysts are grouped under the heading of "Occupational Training and Special Projects." This division into two sections is admittedly somewhat arbitrary, and analysts regularly move back and forth between the two units (i.e., between studies of business establishments and training or special projects). The division of the California center into two units was in fact not internally initiated but was done at the request of state personnel who wanted a separate unit for special projects on the organization chart in order to reflect the field center's responsibility to the state. It was felt that such a division would facilitate a better coordination with state-initiated projects. Thus although on paper the two groups maintain distinct responsibilities, in practice this has not proven to be the case.

In some centers the position of job analyst is viewed as an entry-level position (e.g., Michigan), while in others the position is considered to be at the level of Employment Service manager (e.g., New York). As a result the backgrounds and career patterns of the analysts and hence their degree of achieved proficiency vary quite substantially across centers. The educational requirement is usually a bachelor's degree, although at least one supervisor noted that this requirement had been waived in the past for persons with military or business experience. Many of the job analysts we met came to their job directly from years of experience in the Employment Service or Unemployment Insurance Service, where they had gained knowledge in the use of the DOT. With a degree in one of the social sciences, usually sociology, psychology, or economics, most analysts have followed a typical career progression: from Employment Service interviewer to senior interviewer to occupational analyst. In New York, in order to qualify for the position of occupational analyst, experience as an interviewer is required, and applicants must pass a state civil service examination. The situation is similar in California, where analysts are classified as "research analyst" by the state personnel classification. In order to be promoted, the California analysts must pass state-administered examinations that require a substantial knowledge of economics and statistics, skills that analysts feel are not directly related to their job duties.

In addition to experience and degree requirements, analysts are often chosen on the basis of other skills perceived to be relevant to job analysis. One supervisor mentioned that his center asks candidates to provide a writing sample that consists of a description of their current job. In evaluating this description the supervisor does not look for conformance to occupational analysis guidelines but for general thoroughness and the ability to describe a job in writing. Another supervisor noted that when he hires analysts he looks for individuals with good interpersonal skills, since he believes an important part of the analyst's job involves convincing employers to allow him or her access to their business establishments.

Once hired, analysts go through a formal training program followed by an extended period of informal training by more senior analysts. The analyst is usually considered to be in training until he or she can take complete responsibility for studying an entire industry, usually 1–2 years. Because of this long training period, rapid turnover can seriously disrupt ongoing center activities. Although a few of the centers have experienced disruptive turnover in the recent past (one expressed explanation for this was that little opportunity for upward mobility exists within the centers), some of the analysts have been at OA for many years.

FUNCTIONAL SPECIALIZATION OF THE FIELD CENTERS

Currently, the national office has assigned lead responsibility to various of the field centers for coordinating and managing work on specific topics, such as the revision of the *Handbook for Analyzing Jobs* or planning for the fifth edition DOT. Although primary responsibility remains at the assigned center, various subsections of the task may be distributed to other field centers. The New York field center, for example, has the lead role in revising the *Handbook for Analyzing Jobs.* Although the New York staff are responsible for the major writing tasks involved in the revision, they have asked the California field center to analyze the GED and worker function specifications and the aptitude scales; Utah to revise the SVP specification and the aptitude scales; Seattle to investigate the interests and temperaments codes; and North Carolina to review the materials, products, subject matter, services, and work fields.

In addition to carrying out its part of the revision of the *Handbook for Analyzing Jobs,* the California field center has been given the lead responsibility for planning for the fifth edition DOT. In consultation with the field center coordinating committee and with the North Carolina field center (which has the lead role in developing methods of quality control), the California field center has been instrumental in devising new procedures for upgrading the quality of future editions of the DOT. For example, the method of assigning industries to field centers has been revised so that each center has primary, or lead, responsibility for a smaller number of industries. Previously, in order to increase geographical representation a number of centers shared the responsibility for completing job analysis schedules for a single industry, so each field center was thus responsible for a far greater number of industries.

The North Carolina field center had the primary role in coordinating and producing the fourth edition DOT. Staff at North Carolina were responsible for writing the composite definitions of categories 5 through 9 (processing, machine trades, benchwork, structural work, and miscellaneous occupations—about 80 percent of all definitions), the Florida field center was assigned category 3 (service occupations), the Washington field center was assigned category 4 (agricultural, fishery, forestry, and related occupations), the New York field center was assigned category 2 (clerical and sales occupations), and the California field center and the national office shared the writing for the 0/1 categories (professional, technical, and managerial occupations). Given its overall responsibility for producing the fourth edition DOT, the North Carolina field center was, as we briefly noted above, in a good position to review the quality of the source data on which the composite job definitions are based. Two specific problems were identified by the North Carolina staff: First, the source materials were inadequate, with respect to both the number of individual job analysis schedules and the uneven coverage of jobs by industry. Second, the review procedures set up to monitor the writing process were inadequate.

Specifically, the verification procedure used to produce the fourth edition (a procedure that accounted for more than 30 percent of all job analysis schedules prepared) was viewed as extremely inadequate. The North Carolina staff's view of the thinness of the data base was corroborated by the Booz, Allen & Hamilton, Inc. (1979: Exhibit IV-8) report, which noted that fully 64 percent of the fourth edition DOT definitions were based on two or fewer job analysis schedules. (This point is discussed further in chapter 7.)

Given these perceived inadequacies of the fourth edition data base, the North Carolina field center has promulgated new standards of quality control in order to ensure a more thorough and even coverage of jobs. One of its recommendations is that analysts conduct a top-to-bottom study of business establishments if at all possible. In addition, the California field center is currently preparing a list of jobs most in demand at local Employment Service offices. This list will be used to ensure that the DOT definitions of jobs in greatest demand are based on a sufficient amount of source information. However, so that job analysis schedules will not be overproduced for common jobs, completed schedules will be sent to the North Carolina field center, which will keep track of the amount of source material received.

As a final example of the lead role concept the Texas field center was assigned to provide field center input into the development and maintenance of keywords and the updating of the *Handbook of Occupational Keywords*, a task that involves deciding which keywords to add and which to delete. The keyword system, which provides short descriptors characterizing both applicants and jobs, was designed to enhance the matching of people and jobs via an automated placement process. Overall responsibility for maintenance and updating the keyword system was assigned to the occupational analysis program in 1977 and continues on an ongoing basis.

The responsibility for keyword maintenance and research is generally assigned to at least one person at each field center. The New York field center has assigned two of its analysts to keywording and is currently involved in three projects assessing the adequacy of the system. The Missouri field center has assigned three people to keyword research. Currently, those analysts are checking the appropriateness of the keyword coding of job orders and applicant histories and the frequency of actual job hires using keywords. In addition, they are determining the frequency of use of given keywords in preparation for an anticipated revision of the *Handbook of Occupational Keywords.*

Aside from its ongoing keyword maintenance activity the California field center was assigned the responsibility for a specific keyword research project (subsequently reassigned to the Texas field center): to coordinate the development of a keyword/DOT matrix to identify keyword combinations that can be associated with individual DOT definitions for jobs of high incidence in Employment Service offices. The purpose of the study is to determine how well the *Handbook of Occupational Keywords* differentiates closely related jobs and if a sufficient number of keywords exists for matching orders and applications received in field operations. The matrix will theoretically allow the identification of problem areas and enhance the matching capabilities of the keyword procedure. (For additional details on keywording, see Appendix G.)

MAJOR FIELD CENTER ACTIVITIES

The occupational analysts at the field centers are involved in a variety of activities. The primary function of the field centers, of course, is to provide the raw data used as input into the DOT. Most analysts spend at least part of their time on this activity. Given the cyclical publication of the DOT, however, the total amount of effort devoted to ongoing job analysis is highly variable. Since publication of the fourth edition, the proportion of time spent on production-related DOT activities has decreased considerably. In addition to conducting site visits to business establishments, some analysts also spend time on other activities. We have already discussed the technical studies designed to improve the DOT and the job-matching process. In addition, field center activities include writing national and state career guides and brochures, providing training and technical assistance in job analysis techniques to government and private organizations, and holding seminars and workshops on DOT use and application. Some analysts are also involved in other special projects, usually initiated by state personnel. The remainder of this chapter discusses each of these major roles of the field centers.

Production of the DOT

Activities involved in producing the DOT include job analysis studies, definition writing, development and/or revision of job analysis techniques, and other related activities. During the 8-year period from 1971 through 1978, ongoing studies of business establishments (i.e., job analysis studies) accounted for 61 percent of the total occupational analysis effort, definition writing accounted for 8 percent, and other DOT-related activities accounted for 10 percent (Booz, Allen & Hamilton, Inc., 1979: Exhibit II-2). Members of the small national office staff do not conduct establishment site visits, although they are involved in the writing of composite definitions. Hence by far the largest proportion of the input into the production of the DOT comes from the staff of the local field centers. A detailed discussion of the role of the field center staff in compiling the fourth edition DOT is presented in chapter 6. Specific details are provided on the assignment of industries to field centers, the sampling and selection of establishment sites, on-site job analysis procedures, the preparation of job analysis schedules, and the writing of composite definitions.

One important related function of the field centers is defining and assigning DOT codes to "new" occupations. Each field center has at least one person who handles occupational code requests (OCR's). Many of these requests for new DOT codes originate from Employment Service offices in the federal region in which the field center is located. In addition, some OCR's originate from agencies such as the Bureau of Apprenticeship and Training, which use the specific vocational preparation codes in determining the "apprenticeability" of occupations (see chapter 4 and Appendix B for detailed reports on the Bureau of Apprenticeship and Training's use of the DOT). One supervisor remarked that many of the OCR's coming into his office were from CETA programs, for which it apparently has been common practice to inflate job descriptions in order to obtain higher worker function codes to ensure federal funding for training programs. The supervisor noted that in many of those cases the descriptions could be assigned an already existing DOT code.

When an occupational code request arrives, a standard procedure is followed. The analyst either approves the request for a new number (i.e., documents it as a "new occupation") or assigns an already existing DOT code. An attempt is made to reply to such requests within two working days. Once the initial assignment of a DOT code is made for new occupations, the analyst is supposed to conduct a follow-up site visit, filling out a job analysis schedule and writing a draft composite definition for the occupation. In this manner the DOT is theoretically continually updated to accommodate technological and structural change in the economy. To the extent that the process operates as it is designed, much of the production of the DOT is accomplished along the way and not in a rush as the publication date nears. As we document in chapter 7, this procedure did not operate effectively in the preparation of the fourth edition.

Career Guides and Brochures

The development of career guides and industry brochures is a secondary but major function of the field centers. The basic data for these guides and brochures derive from the business establishment site visits and written industry summaries. These brochures, designed primarily for use by employment counselors in local Employment Service offices, provide information on educational and training requirements and worker characteristics in particular fields or industries. The work on some of these guides and brochures is initiated by the national office, while the impetus for others originates at the state or local level. For example, the California field center is currently involved in the production of several career publications initiated by the national office, including *Career Opportunities in Library Science, Environmental Protection Careers Guidebook,* and *Career Opportunities in Sports and Recreation*. For the state the field center is currently revising the *Career Guides for Entry Occupations,* a series of publications providing occupational information for entry-level jobs in such occupations as nursing, printing, and fire protection. Occasionally, the initiative for developing career brochures comes from the field center itself; the staff approaches Employment Service personnel to determine whether a proposed pamphlet would be helpful for their counseling work. The North Carolina field center has been involved in the production of industry brochures for the tobacco, furniture, and hosiery industries. The New York field center has also been working on career pamphlets, in the areas of criminal justice, mental health, and environmental protection. The Missouri field center has completed a career guide for jobs in zoos and museums. (See chapters 3 and 4 for details on the use of these products.)

Training and Technical Assistance

One of the primary responsibilities of the field centers is to provide training and technical assistance to government agencies and other organizations on the products, methods, and techniques of occupational analysis. This assistance is generally provided at the discretion of the field center supervisor and at no cost to the requester. Training sessions can range from a half-day session to a week-long workshop on DOT use and the application of techniques of job analysis. Another form of technical assistance provided by field center analysts includes giving seminars on various topics (e.g., career opportunities for sociologists with bachelor degrees, career opportunities for women, setting up occupational libraries in career counseling centers). Recipients of this free training and technical assistance include both public and private organizations (e.g., national and regional staff of the Employment and Training Administration, vocational counselors, industry and labor representatives, state agencies, and university personnel).

Training on DOT use and application was an important component of the total work effort of the field centers in 1978, since it was the first year in which the fourth edition DOT was available. The New York field center was responsible for developing the materials used for training interested parties in the use of the DOT and the arrangement and interpretation of the various DOT scales. The California field center set up a worker traits training unit. In addition to providing training on DOT use, occupational analysts also train interested agencies and industry groups on techniques of job analysis. Many of the personnel trained reportedly find the job analysis techniques useful in developing their own job compensation systems. This type of training is carried on at most centers: for example, analysts at the Michigan field center trained vocational rehabilitation groups in job analysis techniques; the New York field center provided a similar public service by assisting a large private firm in developing its own job analysis system.

Special Projects

In addition to the ongoing work of the field centers, some members of the field center staff work on special projects, usually initiated by the state but also occasionally by the national office. Several major special projects initiated by the national office have been discussed in an earlier section (e.g., keyword research, planning for the fifth edition DOT, revising the *Handbook for Analyzing Jobs*). Several other special projects are reviewed here.

Members of the Michigan field center staff have served as consultants for the Detroit public school system. In addition to providing the schools with occupational information, analysts have analyzed student résumés and coded occupational aspirations to the DOT for use in career counseling. This center is also involved in coding state civil service bench mark jobs with the DOT identifiers in order to register state jobs with the Employment Service; it is also considering a request to code the National Longitudinal Survey occupational data with DOT identifiers. Several field centers are currently assigning DOT codes to the occupational descriptions provided by respondents to the March 1978 Current Population Survey.

Finally, the California field center was involved in a survey of third edition DOT use within local Employment Service offices (see chapter 3 for a discussion of the results of this survey). Although the survey was done at the request of the national office, the design of the project and the survey instrument were developed by the field center staff. Information was gathered via interviews with a sample of Employment Service workers in California. The interview instrument was designed to survey users of the third edition DOT in order to compile comments and criticisms concerning the format, ease of use, extent of coverage, and adequacy of the DOT as an information source.

The special projects carried out by the field centers do not generally involve basic research into the theories and methods of job analysis techniques and products. Instead, special projects of the sort described above involve evaluations of DOT use or applications of the accepted DOT methodology. The research that has been conducted has been relatively recent. The California field center has been one of the centers in the forefront of such research. It is currently surveying all occupational analysts in the field centers on a variety of topics, including keywords and the revisions of worker function codes and the GED specification. Two research tasks have been undertaken to revise the GED specification: (1) a reliability study of GED ratings by analysts and (2) a questionnaire sent to all occupational analysts to determine what use is made of the GED specification and to solicit suggestions on how it might be improved. The reliability study involves a test of 27 definitions of varying lengths for which the analysts were asked to code the three subcomponents of GED (i.e., reasoning, math, and language development). As of this writing, results from this study were not available; see chapter 7 for a discussion of our own reliability study of the ratings of various DOT scales. The California field center also is responsible for revising the worker function specifications (the complexity of an occupation's relationship to data, people, and things). Field center personnel concerned with the worker function revision have questioned the ability of the worker function ratings to represent total job complexity and have suggested that the definition of the concept and its use might need to be modified in the future.

The Michigan field center has been involved in research aimed at increasing the coverage and the efficiency of data collection. To identify jobs in its assigned industries that are not covered in the DOT, the field center has developed study matrix charts. These charts, one per industry, array industrial technologies or products by worker function codes. Technology and product categories are largely based on the *Standard Industrial Classification* (SIC) (U.S. Department of Commerce, 1972); the particular combinations of worker functions selected are those that occur most frequently in the DOT for a particular industry. Empty cells in the matrix alert analysts to the possible existence of unanalyzed jobs.

To assist in the selection of establishments to study, the Michigan field center has developed and pretested a planning survey. For each primary DOT industry, firms covered by unemployment insurance are identified by the SIC code and number of employees. Within each detailed industry, firms are stratified by size and sampled proportionately. Questionnaires are then mailed to the firms, requesting information on the presence of jobs and the number of part-time and full-time employees per job. Although the planning survey involves a considerable amount of work, when it is fully implemented, it may offer a promising model for a sound, well-documented procedure for sampling business establishments.

CONCLUSION

Both the organization of the occupational analysis program and its task—collecting information on the job content of the United States economy—are complex. Accomplishing the task would be difficult in the best of organizational circumstances. The recent Booz, Allen & Hamilton, Inc. (1979: Vol 1, chaps. III–V) management study attributes the difficulties of the Division of Occupational Analysis in carrying out its major task—the production of the DOT—to typical kinds of management failure: the lack of clear statements of function, the turnover in the national office directorship, and the failure of the national office staff to take leadership, delegate tasks responsibly, and monitor performance consistently (as indicated by a lack of written directives and oversight mechanisms). In contrast, we conclude that the inherent complexity of the task and the cumbersome nature of a structure based on a federal national office and state field centers are the major reasons for the difficulties, although management failures may also have played a role.

The task of collecting information on every occupation in the American economy in such a way that it is useful in matching people with jobs is a formidable one. It raises basic conceptual questions about the nature, boundaries, and similarities of jobs and occupations, and it raises these questions in an environment that is continually changing. The problem of sampling the economy's jobs appropriately is therefore an extremely difficult one. To accomplish the task requires substantial research on these questions as well as the continual improvement of data collection techniques and of the occupational classification used. Since the production of the third edition DOT the national office has simply not had the resources (or perhaps personnel with the necessary skill, motivation, and understanding) required to do the job. The Division of Occupational Analysis could be the fundamental research unit for the important problem of matching workers and jobs. As such (as Booz, Allen & Hamilton, Inc. also notes) it could have been integrally involved in the automated worker-job matching system being developed by the Employment Service. Our observations confirm the conclusion of Booz, Allen & Hamilton that the research effort of the Occupational Analysis Branch has been inadequate. The Booz, Allen & Hamilton study suggests that the main reason for the failure of the Division of Occupational Analysis, particularly in the area of research, is that it has isolated itself from other units of the Employment Service and maintained a very narrow vision of its task. While our observations do not allow us to make a definitive statement about the source of the program problems, we would point out that rarely does an organizational unit isolate itself without reason or without the cooperation of surrounding units. The Division of Occupational Analysis is charged with a matter of fundamental importance. Its organizational location and support should reflect that importance.

There are problems inherent in the structure of the program, divided as it is between a national office and state-run field centers. The occupational analysis program is small in relation to the others being administered in this way, and its funding needs are often neglected. The national office lacks effective control, not only because the chain of communication is long and cumbersome but also because the field centers have two bosses. The state agencies have direct command over the field centers and their resources, and they can and do request the help of the field centers for state projects. Moreover, the field centers are subject to state budgetary considerations and administrative arrangements, such as bans on out-of-state travel, which sometimes interfere with their work. Finally, the lack of promotional opportunities and standardized job qualifications makes it difficult for the national office to enforce uniform training or performance standards on the analysts from different centers.

Although we have not attempted to investigate the management problems of the Occupational Analysis Branch, we are concerned that inadequate management in a cumbersome organizational structure appears to have contributed to weakening the quality of the *Dictionary of Occupational Titles*. Decentralization coupled with inadequate central administration appears to have had deleterious effects on the uniformity of the data collection procedures used. Our assessment of both the procedures used in compiling the DOT and the resulting quality is described in chapters 6 and 7. Any attempt to improve the quality of the DOT will necessarily involve organizational issues. The exigencies of proper data collection and useful research require standardization, coordination, and monitoring. In a decentralized system of field centers a strong central administration and good communication among the centers are crucial. We are also concerned that the needs of the occupational analysis program not be viewed only from the narrow perspective of management efficiency; the need for occupational information of high quality and the difficulties inherent in meeting this need in a changing economy are concerns of fundamental importance. We return to this issue in chapter 9.

6 Procedures Used to Produce the Fourth Edition *Dictionary of Occupational Titles*

Because the *Dictionary of Occupational Titles* is a dictionary and a reference manual, and because it is widely used and relied on to provide comprehensive, authoritative information about occupations, it is especially important that the information it contains be reliable and accurate. The comprehensiveness, reliability, and accuracy of the DOT are in large part a function of the data collection and analysis procedures used to produce it. This chapter describes these procedures step by step, from the initial selection of industries for study to the final stage of writing definitions for the occupational titles that appear in the published volume. This description, along with the more technical evaluation in chapter 7 of the implications of these procedures for the quality and characteristics of data contained in the DOT, is intended to provide information that will enable users of the DOT to make informed judgments about its value.

In the course of our analysis it became clear that the production of the DOT is seriously underdocumented. Because of the lack of published technical information or documentation of procedures, the description in this chapter draws heavily on information gathered during interviews with staff at the national office and at seven field centers (Arizona, California, Michigan, Missouri, North Carolina, New York, and Texas) as well as on

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Pamela S. Cain had primary responsibility for the preparation of this chapter.

information found in instructional manuals developed primarily for internal use, the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972) and the *Definition Writer's Manual* (U.S. Department of Labor, 1974).

HISTORICAL BACKGROUND

The procedures used to produce the fourth edition DOT were originally developed by two different research programs dating from 1934 and 1949. The first program of occupational research was initiated in response to the depression. At that time the large number of unemployed, qualified workers made job matching on the basis of work performed, by comparing an applicant's work history with a job order, relatively easy. Occupational research at this early stage hence focused primarily on job content. The research begun in 1934 formulated major principles of job analysis methodology for the DOT and set in place sampling techniques and on-site procedures for the study of business establishments that are still used in the program today.

World War II and postwar economic recovery prompted an influx into the labor force of workers who had little or no prior labor force experience or up-to-date job skills. Increasingly, it was necessary to match jobs to workers on the basis of an applicant's potential to perform a given job rather than his or her demonstrated expertise. In 1949 the functional occupational research project was begun to investigate systematically various dimensions of worker potential. This research, which culminated in the third edition DOT (1965), introduced worker functions in relation to data, people, and things into the DOT classification scheme, standardized definition writing, and developed various scales for rating worker traits. Since publication of the third edition DOT in 1965, few, if any, modifications appear to have been made in the basic methodology of the occupational analysis program.

SAMPLING FOR THE DOT

Sampling for the fourth edition DOT was by no means straightforward. The sampling universe was all jobs in the national economy. Conceptually, the economy was categorized by occupations. For purposes of collecting data about occupations, however, the economy was categorized by industries; that is, industries were the basic units by which assignments were made to the field centers. Once field centers received their industry assignments, they were responsible for obtaining complete coverage of the jobs within their assigned industries. In order to study jobs, however, the business establishments in which jobs are found had to be located. Only after this had been done were jobs finally selected and analyzed.

This multistage selection process identified an increasingly disaggregated unit of analysis; the process then shifted direction: for purposes of compiling the DOT, data about jobs were aggregated to form occupations. Occupations in the DOT are not intended to be either firm or region specific, and in some cases not even industry specific. Rather, the descriptions are intended to reflect the occupation as it typically occurs in the national economy, although what is meant by "typical" is not explicitly defined. The various steps involved in the creation of the fourth edition DOT, from industry assignment to occupational composite, are described in the subsequent sections of this chapter.

ASSIGNMENT OF INDUSTRIES TO FIELD CENTERS

Shortly after the completion of the third edition DOT, industry assignments were made for the fourth edition. Most centers were assigned the same set of industries for which they were responsible in the third edition. Although there is no documentation of how assignments were made, in matching centers and industries, national office staff appear to have relied on a combination of common sense and general knowledge as well as on their own experience in occupational analysis.

It was impossible to determine conclusively the basis or criteria of industry assignment. When national office staff were queried as to how assignments had been made, responses were vague. North Carolina, for example, was said to be the "logical place for machine textiles and wood furniture"; similarly, Washington was said to be "the natural place" for aeronautics, given the location of Boeing in Seattle; while it was "pretty obvious that Texas doesn't have logging."

For relatively widespread or highly visible industries the rationale for assignment was of this common sense variety. For other, more obscure, industries the assignment of which was not so obvious, various documents were consulted. The annually published *Thomas Industrial Register*, for example, was consulted frequently for this purpose. It was said to be of limited usefulness, however, because it lists a company's home office rather than its production sites. In addition, various state and local industrial or manufacturing directories were consulted on a case-by-case basis, as were assorted federally produced censuses of manufacturers and businesses. Generally, industries were assigned to centers in whose state or region they were thought likely, or sometimes actually determined, to be located.

Large industries, such as banking and financial institutions, were usually assigned to more than one field center to ensure adequate coverage and to detect regional variations in jobs. Groups of related occupations that are not industry specific (e.g., the "any industry" designation) were assigned en bloc to a given center. Assignments were made using the 229 industry designations of the third edition. The number of industries assigned per field center is given in Table 6-1. Fourteen industries (6 percent of the total) were unassigned, and no new job analyses were collected from them; 40 percent were assigned to one field center; and the remaining 54 percent were assigned to two or more field centers. On average, each center was responsible for 42 industries, ranging from 11 for the Arizona special project to 84 for California. Certain field centers appear to have had greater responsibility for industry coverage than others. California, for example, was assigned the largest number of industries and was solely responsible for 9 percent of the 232 industries in the fourth edition DOT industry designation. New York had the second largest number of industries and was solely responsible for 8 percent of the total. Washington was assigned a smaller number of industries and had sole responsibility for

TABLE 6-1 Field Center Industry Assignments

Center[a]	Number of Industries Assigned	Number Uniquely Assigned
Arizona (2)	11	1
California (16)	84	20
Florida (8)	28	0
Michigan (12)	35	17
Missouri (12)	62	13
New York (18)	58	18
North Carolina (21)	39	12
Texas (7)	25	2
Utah (9)	45	4
Washington (12)	44	1
Wisconsin (12)	33	5
Unassigned	14	—
TOTAL	478[b]	93

[a] Number in parentheses following field center is number of analysts on staff.

[b] Total does not equal 232 because some industries were assigned to more than one field center.

SOURCE: Booz, Allen & Hamilton, Inc. (1979: Exhibit IV-3).

only one industry. Since these three field centers have approximately the same number of analysts, the reason for this apparently uneven distribution of responsibility is unclear.

ESTABLISHMENT SELECTION

Once field centers received their assignments, they independently determined how best to fulfill them. Although the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972) provides relatively detailed information on how to conduct a job analysis study within a firm, it contains virtually no guidance on how to go about studying an industry per se or on how to select firms within an industry. In most field centers each analyst was given sole or lead responsibility for a set of industries. The number assigned per analyst varied by the size of the industries involved and by other factors such as the size of the field center and the extent of its involvement in activities other than job analysis (see chapter 5 for a discussion of field center organization and activities).

Analysts pursued their assignments relatively autonomously. There are indications that field centers varied in the degree of supervision or direction given to analysts. Several centers instituted informal procedures whereby analysts submitted a general study design to the center supervisor or supervisory analyst before proceeding, but this was not required by the national office. Analysts typically began by doing background research on the industry in question in order to acquaint themselves with its processes, products, and jobs. This usually involved library research and reference to the appropriate trade publications, the *Standard Industrial Classification* (U.S. Department of Commerce, 1972), the *Occupational Outlook Handbook* (U.S. Department of Labor, 1978a), and others. Some analysts also consulted old job analysis schedules and occupational code requests as background material. The *Standard Industrial Classification* appears to have been especially useful at this point. Because it is much more detailed than the DOT's industry designations, it provided a means by which analysts could determine an industry's subgroupings and hence develop a framework for pursuing their assignment.

As soon as analysts were satisfied that they were familiar with the industry and the types of jobs found in it, they selected establishments that seemed likely to have jobs typical of the industry. In locating establishments, analysts relied on various sources: industrial registers (e.g., Thomas; Dun & Bradstreet), the classified sections of telephone directories, ES-202 forms (submitted to state Employment Service offices by companies that contribute to unemployment insurance), directories of trade and professional associations, indexes of local manufacturers, and publications of the Better Business Bureau and the Chamber of Commerce. Many of these publications contain a good deal of information on the firms available for study in the field center's area, often listing the firm's SIC code, address, the names of company officers, the number of employees (sometimes disaggregated by sex), and the products manufactured.

Despite the absence of guidelines, there was substantial uniformity among the field centers on the criteria used for the selection of establishments. The primary criterion appears to have been proximity to the center. For some field centers, proximity meant the larger federal region in which they were located; others stayed within their state borders (those with state-imposed restrictions on out-of-state travel); and others stayed within the immediate metropolitan area. One field center supervisor reported, for example, that analysts traveled to firms outside the city in which the field center was located "only as a last resort." Overall, the bias appears to have been toward staying as close as possible to the field center in fulfilling assignments.

Analysts attempted to select at least one small, one medium, and one large establishment within an industry or (for large industries) subindustry. Analysts repeatedly expressed the opinion that size was an especially important source of variation in jobs. In their experience, what was a single job in a small company would often be broken up into several jobs in a large firm. Size was apparently assessed by referring to information on the relative number of employees in various establishments in the area. Although this assessment appears to have been a rather casual one, in at least one field center the supervisor reported that the size distribution of local establishments in a particular industry was obtained from locally available publications and divided into thirds so that one or two establishments could be selected for study within each third. Analysts also tried to select establishments that they believed might be employing new or emerging technologies, on the assumption that new jobs would be available for job analysis.

Having completed background research on the industry in question and having selected several possible establishments for study, analysts then attempted to gain the employer's consent to go on site for job analysis. Thus availability, predicated on employers' consent, was the final criterion of establishment selection. Various approaches were used to gain access. The supervisor of one field center reported having the local Employment Service office set up the initial meeting between the analyst and company personnel. At most field centers, however, analysts contacted the appropriate company officer and arranged for the study on their own. Without exception, analysts reported that they tried to talk to the most senior person in the company and were more successful in gaining access when they did so. To obtain an employer's consent, analysts used a "sales pitch," emphasizing the benefits to the employer of the data to be collected. In unionized companies, union consent sometimes was required, although it was usually sufficient merely to notify unions when analysts were to be on site.

It was difficult to determine the degree to which or the circumstances under which employers cooperated or refused to cooperate in a study. Although at least one field center maintained a file of all establishment contacts and their outcome (including, when applicable, the reason for refusal), field centers were not required to do so. As a result, there appears to be no systematic way of assessing the extent, nature, or implications of employers' noncooperation.

We received mixed reports about the rate of refusal. There appears to have been a good deal of variation across field centers. No clear picture emerged as to the type of company most likely to have refused. Analysts at two field centers reported that small companies were more likely to do so and attributed this to the independent, "get-off-my-back" style of many such firms and to their general antipathy toward government intervention of any sort. At another field center, however, analysts could discern no pattern to nonresponse, saying that small companies were no more likely to refuse than large ones. There was some feeling that large companies were more cooperative than small ones. Gaining access to large companies often entailed extensive negotiations and permission from the company's home office (often located in another state or region), but several analysts said that if they persevered, they were usually successful.

JOB ANALYSIS PROCEDURES

Before beginning an establishment study, analysts discussed the proposed study with the employer or supervisory personnel, explaining its purpose and intent, going over procedures, and learning the physical layout of the firm. Even when employers agreed to allow a study to be conducted, they sometimes imposed certain restrictions on analysts' activities. It was reported, for example, that employers (and unions) typically did not permit analysts to use tape recorders or decibel meters in the analysis of production jobs. Some jobs were declared off limits for security reasons, usually to protect a unique aspect of a manufacturer's production process.

STAFFING SCHEDULE AND ORGANIZATION AND PROCESS FLOW CHARTS

In the next step of a typical study, analysts completed a form called a staffing schedule, a copy of which is shown in Figure 6-1. Instructions for completing the staffing schedule are laid out in some detail in the *Handbook for Analyzing Jobs* (U.S. Department of Labor (1972), hereafter referred to as the *Handbook*). Schedules were completed for every division of an establishment if it was analyzed in its entirety or, if only a portion was analyzed, for the relevant divisions or departments.

The staffing schedule was usually prepared with the assistance of the establishment's personnel office or supervisor. If a company had a personnel office, analysts usually copied its records verbatim to complete portions of the staffing schedule. Otherwise, they compiled the necessary data anew. The staffing schedule has two parts, a face sheet and a title sheet. On the face sheet, analysts entered identifying information about the establishment (a unique control number assigned by the field center and a *Standard Industrial Classification* code) and names of products manufactured or services rendered. Analysts then completed one or more title sheets. To do so, they listed company job titles by organizational units for the entire establishment or for the divisions in which they were interested. For each job the total number of workers was recorded, as were subtotals broken down by sex and by shift, if applicable. If the job was entry level, this was also noted. Although it is nowhere stated in the *Handbook*, it was reported to us that part-time and trainee jobs were not listed on the title sheet and hence were excluded from study.

On the basis of a preliminary inspection during a plant tour and/or in consultation with management or other personnel, analysts then determined for each job whether it was substantially similar in basic tasks and requirements to a job definition in the third edition DOT. If so, a third edition title and preliminary code were entered in the appropriate space on the staffing schedule. If a job was a combination of two or more DOT occupations, all the applicable titles and codes were entered; if a job could not be converted to a third edition code, the space was left blank.

This comparison of jobs in an establishment against third edition titles determined the scope and direction of the ensuing study. Jobs that could be converted to a DOT definition but were not specific to the industry being studied (e.g., clerical jobs in manufacturing industries) were not supposed to be analyzed. Instructions in the *Handbook* are ambiguous about whether all remaining jobs are supposed to be analyzed. It appears that they should be, but departures from complete top-to-botton studies were not uncommon.

U.S. Department of Labor
Manpower Administration

OMB 44-R0722

CONFIDENTIAL STAFFING SCHEDULE
(Face Sheet)

Establishment Number 360-150-392 Number of Title Sheets Attached 3

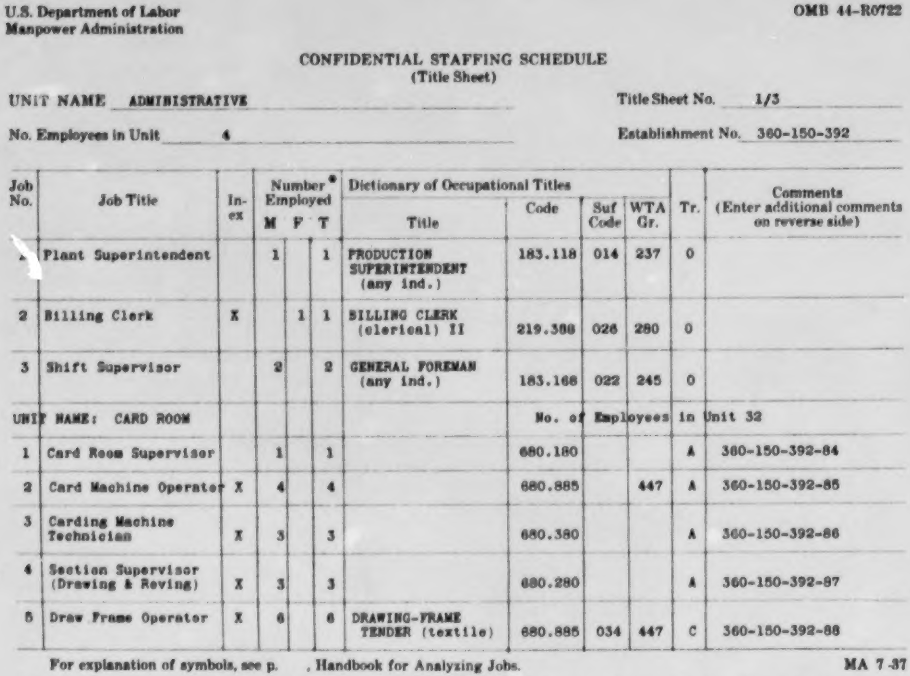
SIC Group(s) & Code(s) Yarn Spinning Mills; Cotton, Man-Made Fibers and Silk - 2281

Number of Employees 150 Analyst's Name John Doe Date 7/1/70

Products Manufactured or Services Rendered: This establishment is engaged in spinning yarn from synthetic fibers for use in manufacturing pile fabrics, hosiery, and men's and women's outerwear.

Remarks: This plant utilizes an automated continuous processing system in which opening and picking processes are eliminated.

MA 7-37



U.S. Department of Labor
Manpower Administration

OMB 44-R0722

CONFIDENTIAL STAFFING SCHEDULE
(Title Sheet)

UNIT NAME ADMINISTRATIVE

Title Sheet No. 1/3

No. Employees in Unit 4

Establishment No. 360-150-392

Job No.	Job Title	In-ex	Number* Employed			Dictionary of Occupational Titles				Tr.	Comments (Enter additional comments on reverse side)
			M	F	T	Title	Code	Suf Code	WTA Gr.		
[illegible]	Plant Superintendent		1		1	PRODUCTION SUPERINTENDENT (any ind.)	183.118	014	237	0	
2	Billing Clerk	X		1	1	BILLING CLERK (clerical) II	219.388	026	280	0	
3	Shift Supervisor		2		2	GENERAL FOREMAN (any ind.)	183.168	022	245	0	
UNIT NAME: CARD ROOM							No. of Employees in Unit 32				
1	Card Room Supervisor		1		1		680.180			A	360-150-392-84
2	Card Machine Operator	X	4		4		680.885		447	A	360-150-392-85
3	Carding Machine Technician	X	3		3		680.380			A	360-150-392-86
4	Section Supervisor (Drawing & Roving)	X	3		3		680.280			A	360-150-392-87
5	Draw Frame Operator	X	6		6	DRAWING-FRAME TENDER (textile)	680.885	034	447	C	360-150-392-88

For explanation of symbols, see p. , Handbook for Analyzing Jobs.

MA 7-37

*As of November 1978, data on the number of workers per job are no longer broken down by sex.

FIGURE 6-1 Staffing schedule. Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:20–21).

For jobs that could not be converted to a third edition title, a complete job analysis was undertaken. A slightly abbreviated analysis was made of jobs that could be converted as well as of jobs that could not be converted but that the analyst knew had already been analyzed in other establishments. At a later date, after they had finished analyzing jobs in the establishment, analysts entered "treatment codes" for the remaining jobs to indicate how thoroughly each had been studied.

In the final step before beginning the intensive analysis of particular jobs, analysts diagramed the company's organization arrangements, indicating lines of authority between different divisions. They also prepared a "process flow chart" to depict the "sequence of procedures or processes at the establishment: (a) if industrial, from arrival of raw materials to shipment of finished product; (b) if service, from entry of client or material into the service until the service is completed on the individual or item" (*Handbook*, p. 55). Process flow charts were usually prepared only for company divisions that were directly engaged in production and not for supporting departments such as quality control, sales, accounting, etc. These departments, however, were included in the organization chart. The *Handbook* offers very little instruction about the completion of either the organization or the process flow charts, and it seems that frequently these charts were not prepared.

JOB ANALYSIS

All of the information obtained for the staffing schedules, organization arrangements, and process flow charts was intended to assist analysts in identifying jobs for study and in keeping track of their progress as the establishment study proceeded. The *Handbook* (p. 3) defines "job" as "a group of positions which are identical with respect to their major or significant tasks and sufficiently alike to justify their being covered by a single analysis. There may be one or many persons employed in the same job." The various components of a job according to the methodology used in the occupational analysis program are elements, tasks, and positions. "Element" is "the smallest step into which it is practicable to subdivide any work activity"; "task" is "one or more elements" that form a distinct activity or step in the performance of work; and "position" is "a collection of tasks constituting the total work assignment of a single worker" (*Handbook*, p. 3). Thus there is a one-to-one correspondence between a worker and a position. Despite these conceptual distinctions between a job and its component parts, analysts generally accepted the establishment's definition of which positions constituted a job.

Job analysis for the DOT is based on a combination of observation and interviews of workers performing a particular job. Although analysts usually asked to observe average workers, employers frequently directed them toward their best workers. When this occurred, most analysts tried to observe other workers in the job. Some analysts, however, preferred to observe and interview better workers, who were thought to be more knowledgeable and articulate about their jobs. Analysts usually observed one or two workers for each job they analyzed.

The conduct of the observation and interviews was structured to some extent by the requisites of the job analysis schedule, which is discussed in more detail later in this chapter. With an eye to completing the schedule, analysts noted the tasks entailed in the job and the percentage of time spent on each; the machines, tools, or work aids used; working conditions; and a variety of other information. Analysts either recorded data directly onto the job analysis schedule, recorded it on worksheets developed by the local field center, or simply took notes that they later transcribed. One analyst estimated that about 65 percent of the analyst's time was spent interviewing workers or their supervisors and the rest in observing and taking notes on the conditions of work, work aids, products produced, etc. Job data obtained from observing and interviewing workers were usually checked with the workers' immediate supervisor.

In some situations the analyst was unable to talk directly with the worker. For production work this most frequently occurred when workers were engaged in complex or protracted tasks, on an assembly line in which the pace had to be maintained, doing piecework, and/or in noisy surroundings. For other kinds of jobs this limitation arose when workers were involved in a wide variety of tasks over long periods of time. The *Handbook* offers no clear-cut alternative procedures for obtaining data about jobs in such situations, advising only (p. 14) "(1) using establishment job descriptions or specifications supplemented by discussions with administrative and technical personnel; (2) obtaining job descriptions, specifications, hiring requirements, and related data for certain jobs from associations, societies, and other similar organizations; or (3) interviewing workers, supervisors, and/or management in a place apart from the work site." In an effort to deal with this problem for clerical jobs, one field center developed a special questionnaire to ascertain job tasks and requirements. The questionnaire was completed by the worker and followed up by analysts with a brief interview.

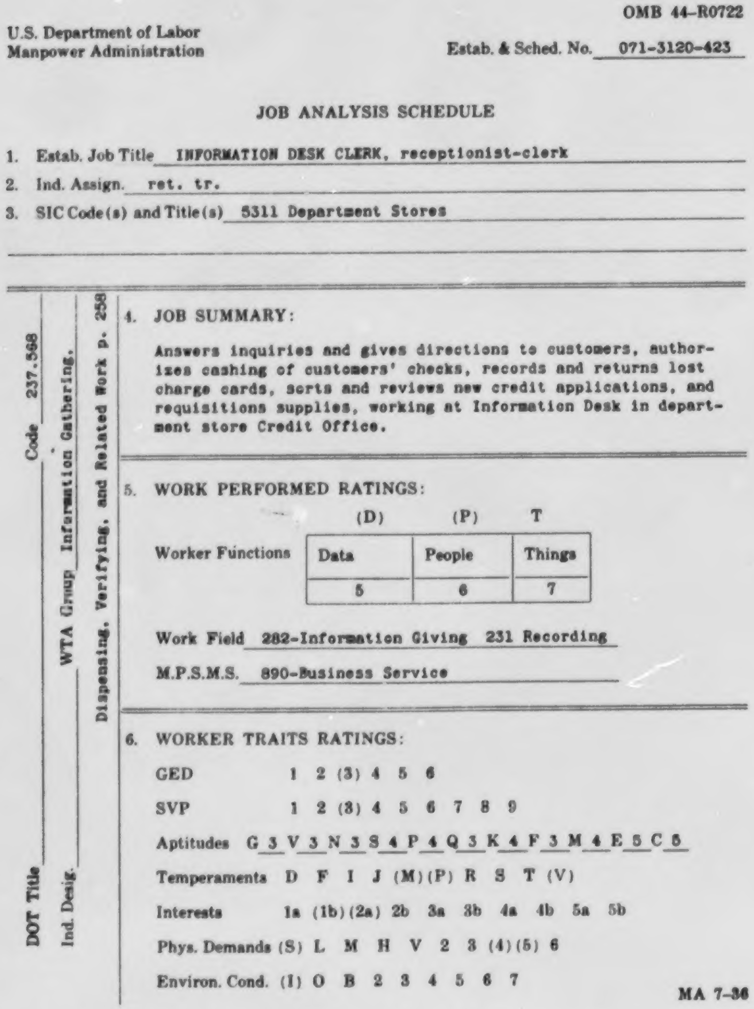
These data collection procedures were repeated for each job in the establishment for which an analysis was needed. Depending on the size of the establishment and the number of jobs to be analyzed, the on-site analysis portion of an establishment study took between 1 week and 2 months to complete. Usually, analysts had to work fairly rapidly so as not to disrupt the company's work routine. Once they completed their on-site analysis, it was usually difficult to return to the establishment for a second round of observations.

Writing the Job Description and Assigning a DOT Code

Having completed the on-site establishment study and with data in hand for a number of jobs, analysts reviewed their work before filling out a job analysis schedule for each job. Completion of the job analysis schedule, an example of which is given in Figure 6-2, required analysts to supply information about the job (e.g., establishment job title, SIC code and title), to write a job summary, and to code and/or rate much of the information they had gathered. The job summary provides information on the purpose and nature of the job and on the level and significance of the worker's involvement with data, people, and things. The analyst also listed licenses or certification required for the job; noted the job's relationship to other jobs in the firm; listed and described (if relevant) machines, tools, equipment, and work aids used by the worker and materials and products with which the worker was involved; provided a detailed description of job tasks (including percentage of time devoted to each); and defined terms used in the schedule that could not be found in a standard dictionary. If a particular job could be converted to a third edition DOT code (treatment type C) or was similar to a job for which the analyst knew a schedule had already been prepared (treatment type V), the detailed description of job tasks was not provided. Instead, analysts listed only significant differences between the job being analyzed and the DOT definition or original job description.

In light of the above information the analyst assigned numerical codes (available from the *Handbook*) for each of the following: (1) one or more of the 100 work fields (e.g., hunting-fishing, butchering, research), which relate to "specific methodology(ies) used in the job-worker situation" (*Handbook*, p. 27), (2) one or more materials, products, subject matter, or services (MPSMS) (e.g., lumber and wood products, business services and administration) that together with the work field(s) reflect "the specific technology with which the worker is involved" (*Handbook*, p. 27), (3) worker functions measuring the complexity in relation to data, people, and things. On the basis of job tasks, analysts indicated whether the relationship was significant according to the highest level of worker's involvement on each of the three dimensions. To assist analysts in completing this portion of the schedule, the *Handbook* provides descriptive examples of each level.

On the basis of these ratings and the job summary the analyst then



OMB 44-R0722

U.S. Department of Labor
Manpower Administration

Estab. & Sched. No. 071-3120-423

JOB ANALYSIS SCHEDULE

1. Estab. Job Title INFORMATION DESK CLERK, receptionist-clerk
2. Ind. Assign. ret. tr.
3. SIC Code(s) and Title(s) 5311 Department Stores

DOT Title ___ Code 237.368

Ind. Desig. ___ WTA Group Information Gathering, Dispensing, Verifying, and Related Work p. 258

4. JOB SUMMARY:

Answers inquiries and gives directions to customers, authorizes cashing of customers' checks, records and returns lost charge cards, sorts and reviews new credit applications, and requisitions supplies, working at Information Desk in department store Credit Office.

5. WORK PERFORMED RATINGS:

	(D)	(P)	T
Worker Functions	Data	People	Things
	5	6	7

Work Field 282-Information Giving 231 Recording

M.P.S.M.S. 890-Business Service

6. WORKER TRAITS RATINGS:

GED 1 2 (3) 4 5 6

SVP 1 2 (3) 4 5 6 7 8 9

Aptitudes G 3 V 3 N 3 S 4 P 4 Q 3 K 4 F 3 M 4 E 5 C 5

Temperaments D F I J (M) (P) R S T (V)

Interests 1a (1b) (2a) 2b 3a 3b 4a 4b 5a 5b

Phys. Demands (S) L M H V 2 3 (4) (5) 6

Environ. Cond. (I) O B 2 3 4 5 6 7

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FIGURE 6-2 Job analysis schedule. Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:37-41).

Continued overleaf

7. General Education

a. Elementary 6 High School none Courses

b. College none Courses

8. Vocational Preparation

a. College none Courses

b. Vocational Education none Courses

c. Apprenticeship none

d. Inplant Training none

e. On-the-Job Training 3 to 5 weeks by Credit Interviewer

f. Performance on Other Jobs none

9. Experience none

10. Orientation 1 week

11. Licenses, etc. none

12. Relation to Other Jobs and Workers

Promotion: From this is an entry job To CREDIT INTERVIEWER

Transfers: From none To none

Supervision Received CREDIT MANAGER

Supervision Given none

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13. Machines, Tools, Equipment, and Work Aids
Impressing Device - Small Hand-operated device, of similar construction to stapler with a nonmoving base and a moveable upper arm (cont'd)

14. Materials and Products

none

FIGURE 6-2 Continued

15. **Description of Tasks:**

1. Answers inquiries and gives direction to customers: Greets customers at Information Desk and ascertains reason for visit to Credit Office. Sends customer to Credit Interviewer to open credit account, to Cashier to pay bills, to Adjustment Department to obtain correction of error in billing. Directs customer to other store departments on request, referring to store directory. (50%)

2. Authorizes cashing of checks: Authorizes cashing of personal or payroll checks (up to a specified amount) by customers desiring to make payment on credit account. Requests identification, such as driver's license or charge card, from customers, and examines check to verify date, amount, signature, and endorsement. Initials check, and sends customer to Cashier. Refers customer presenting Stale Date Check to bank. (5%)

3. Performs routine clerical tasks in the processing of mailed change of address requests: Fills out Change of Address form, based on customer's letter, and submits to Head Authorizer for processing. Files customer's letter. Contacts customer to obtain delivery address if omitted from letter. (10%)

4. Answers telephone calls from customers reporting lost or stolen charge cards and arranges details of cancellation of former card and replacement: Obtains all possible details from customer regarding lost or stolen card, and requests letter of confirmation. Notifies Authorizer immediately to prevent fraudulent use of missing card. Orders replacement card for customer when confirming letter is received. (10%)

5. Records charge cards which have inadvertantly been left in sales departments and returns them to customer: Stamps imprint of card on sheet of paper, using Imprinting Device. Dates sheet and retains for own records. Fills out form, posting data such as customer's name and address and date card was returned, and submits to Authorizer.

FIGURE 6-2 Continued

Continued overleaf

Makes impression of card on face of envelope, inserts card in envelope, and mails to customer. (5%)

6. Sorts and records new credit applications daily: Separates regular Charge Account applications from Budget Accounts. Breaks down Charge Account applications into local and out-of-town applications and arranges applications alphabetically within groups. Counts number of applications in each group and records in Daily Record Book. Binds each group of applications with rubber band, and transmits to Tabulating Room. (10%)

7. Prepares requisitions and stores supplies: Copies amounts of supplies requested by Credit Department personnel onto requisition forms. Submits forms to Purchasing Officer or Supply Room. Receives supplies and places them on shelves in department store storeroom. (10%)

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16. Definition of Terms

Stale Date Checks — More than 30 days old

17. General Comments

none

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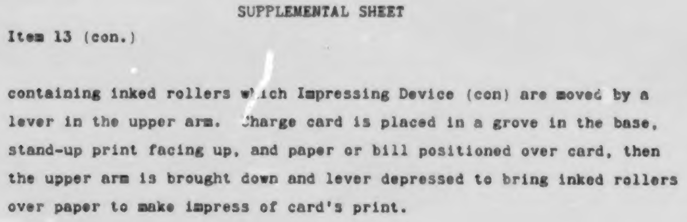
18. Analyst A. Yessarian Date 7/25/70 Editor M. Major Date 7/26/70

Reviewed By John Milton Title, Org. Credit Manager

National Office Reviewer W. Irving

FIGURE 6-2 Continued



SUPPLEMENTAL SHEET

Item 13 (con.)

containing inked rollers which Impressing Device (con) are moved by a lever in the upper arm. Charge card is placed in a grove in the base, stand-up print facing up, and paper or bill positioned over card, then the upper arm is brought down and lever depressed to bring inked rollers over paper to make impress of card's print.

FIGURE 6-2 Continued

TABLE 6-2 Worker Trait Summary

Worker Trait	Number of Factors
Training time	4
Aptitudes	11
Temperaments	10
Interests	5
Physical demands	6
Environmental conditions	7
TOTAL	43

assigned the job its DOT code: the first three digits were assigned primarily on the basis of work fields and MPSMS; the next three digits are the worker function ratings of actual level (rather than significance) of involvement. If the job was identical in all significant respects to a published definition, the analyst also entered a DOT title and industry designation for it.

Rating Worker Traits

Another step in completing the job analysis schedule entailed rating jobs for the six types of worker traits discussed in chapter 2. In all, this involved assigning scores on 43 distinct factors, as shown in Table 6-2. The rating task was by no means straightforward, requiring detailed knowledge about the job as well as a great deal of judgment on the part of the analyst, since many of the factors were not easily observed or measured. To assist analysts in rating worker traits, the *Handbook* contains numerous illustrative situations or bench marks for each level of each factor of each trait. Analysts' opinions of the usefulness of these bench marks were mixed, however. Some analysts did not find them comprehensive enough; some found them inconsistent, contradictory, and confusing; and some apparently felt that they were adequate. The *Handbook* also provides instructions as to how and on what basis each worker trait should be assigned. Both these instructions and the definitions of the traits are brief and vague, consisting usually of only one or two paragraphs.

Each job was evaluated for three categories of GED (reasoning, math, and language), for which the scale is given in Figure 6-3. After determining the level required in each category the analyst selected the highest level of the three to express the final GED for the job. For SVP, analysts assigned one of nine levels, which correspond to ranges of training time but do not reflect the type of training or where it has been acquired

(SVP rating levels are shown in Figure 6-4). The SVP was reported to be difficult to rate because the frame of reference for measuring the amount of training was unclear.

Training times were determined by considering a variety of data collected during the on-site study: employer's hiring requirements, union specifications, workers' qualifications, types of work aids used (e.g., calculators, gauges, etc.), and types of tasks performed (e.g., arithmetic calculations, writing, etc.). The *Handbook* cautions analysts not to rely too heavily on the qualifications demanded by the employer or union or on those that workers bring to the job but rather to assign GED and SVP primarily on the basis of skills or tasks intrinsic to job performance. According to most analysts' reports, however, employers' hiring requirements figured prominently in the assignment of these ratings, especially SVP.

The analyst next rated jobs for 11 aptitudes indicating the level of each aptitude required for "average, satisfactory performance" (*Handbook*, p. 233). A single rating scheme, shown in Figure 6-5, is used for all aptitudes. Scores of 1 (high) to 4 (low) were assigned to indicate the level required for satisfactory performance; 5 was assigned if the aptitude was not required to perform the job. Level 5 could not be assigned on the intelligence aptitude (G), however, since it was "assumed that every job requires at least a '4' level of this aptitude" (*Handbook*, p. 294).

Temperaments were rated next. The temperament component consists of 10 factors, shown in Figure 6-6. In rating temperaments the analyst selected those that were "important in relation to the kinds of adjustments which the worker must make for successful job performance" (*Handbook*, p. 313). The presence or absence of a given temperament, rather than the level or degree required, was indicated. The analyst next evaluated jobs for each of five pairs of bipolar interests, selecting those that were important for job performance, thereby automatically rejecting the other of the bipolar pair. The interest factors are shown in Figure 6-7.

The aptitude, temperament, and interest traits were generally perceived to be more ambiguous than the others. Analysts could offer no ready explanation for how they decided on these ratings, other than to say that they learned through experience or that it was a matter of getting a feel for the job. Aptitude ratings were evidently especially difficult. A number of analysts said that they would have felt much more confident about indicating the presence or absence of an aptitude rather than the degree required. Since for the temperaments and interests an indication of simple presence or absence was all that was necessary, these ratings appear to have posed fewer problems.

Finally, jobs were rated for each of the following six physical demands

LEVEL	REASONING DEVELOPMENT	MATHEMATICAL DEVELOPMENT	LANGUAGE DEVELOPMENT
6	Apply principles of logical or scientific thinking to a wide range of intellectual and practical problems. Deal with nonverbal symbolism (formulas, scientific equations, graphs, musical notes, etc.) in its most difficult phases. Deal with a variety of abstract and concrete variables. Apprehend the most abstruse classes of concepts.	Advanced calculus: Work with limits, continuity, real number systems, mean value theorems, and implicit function theorems. Modern algebra: Apply fundamental concepts of theories of groups, rings, and fields. Work with differential equations, linear algebra, infinite series, advanced operations methods, and functions of real and complex variables. Statistics: Work with mathematical statistics, mathematical probability and applications, experimental design, statistical inference, and econometrics.	Reading: Read literature, book and play reviews, scientific and technical journals, abstracts, financial reports, and legal documents. Writing: Write novels, plays, editorials, journals, speeches, manuals, critiques, poetry, and songs. Speaking: Conversant in the theory, principles, and methods of effective and persuasive speaking, voice and diction, phonetics, and discussion and debate.
5	Apply principles of logical or scientific thinking to define problems, collect data, establish facts, and draw valid conclusions. Interpret an extensive variety of technical instructions in mathematical or diagrammatic form. Deal with several abstract and concrete variables.	Algebra: Work with exponents and logarithms, linear equations, quadratic equations, mathematical induction and binomial theorem, and permutations. Calculus: Apply concepts of analytic geometry, differentiations and integration of algebraic functions with applications. Statistics: Apply mathematical operations to frequency distributions, reliability and validity of tests, normal curve, analysis of variance, correlation techniques, chi-square application and sampling theory, and factor analysis.	Same as Level 6.

4	Apply principles of rational systems[1] to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists. Interpret a variety of instructions furnished in written, oral, diagrammatic, or schedule form.	Algebra: Deal with system of real numbers; linear, quadratic, rational, exponential, logarithmic, angle and circular functions, and inverse functions; related algebraic solution of equations and inequalities; limits and continuity, and probability and statistical inference. Geometry: Deductive axiomatic geometry, plane and solid; and rectangular coordinates. Shop Math: Practical application of fractions, percentages, ratio and proportion, mensuration, logarithms, slide rule, practical algebra, geometric construction, and essentials of trigonometry.	Reading: Read novels, poems, newspapers, periodicals, journals, manuals, dictionaries, thesauruses, and encyclopedias. Writing: Prepare business letters, expositions, summaries, and reports, using prescribed format and conforming to all rules of punctuation, grammar, diction, and style. Speaking: Participate in panel discussions, dramatizations, and debates. Speak extemporaneously on a variety of subjects.
3	Apply commonsense understanding to carry out instructions furnished in written, oral, or diagrammatic form. Deal with problems involving several concrete variables in or from standardized situations.	Compute discount, interest, profit, and loss; commission, markup, and selling price; ratio and proportion, and percentage. Calculate surfaces, volumes, weights, and measures. Algebra: Calculate variables and formulas; monomials and polynomials; ratio and proportion variables; and square roots and radicals. Geometry: Calculate plane and solid figures; circumference, area, and volume. Understand kinds of angles, and properties of pairs of angles.	Reading: Read a variety of novels, magazines, atlases, and encyclopedias. Read safety rules, instructions in the use and maintenance of shop tools and equipment, and methods and procedures in mechanical drawing and layout work. Writing: Write reports and essays with proper format, punctuation, spelling, and grammar, using all parts of speech. Speaking: Speak before an audience with poise, voice control, and confidence, using correct English and well-modulated voice.

FIGURE 6-3 Scale for general educational development (GED). Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:210–211).

LEVEL	REASONING DEVELOPMENT	MATHEMATICAL DEVELOPMENT	LANGUAGE DEVELOPMENT
2	Apply commonsense understanding to carry out detailed but uninvolved written or oral instructions. Deal with problems involving a few concrete variables in or from standardized situations.	Add, subtract, multiply, and divide all units of measure. Perform the four operations with like common and decimal fractions. Compute ratio, rate, and percent. Draw and interpret bar graphs. Perform arithmetic operations involving all American monetary units.	Reading: Passive vocabulary of 5,000–6,000 words. Read at rate of 190–215 words per minute. Read adventure stories and comic books, looking up unfamiliar words in dictionary for meaning, spelling, and pronunciation. Read instructions for assembling model cars and airplanes. Writing: Write compound and complex sentences, using cursive style, proper end punctuation, and employing adjectives and adverbs. Speaking: Speak clearly and distinctly with appropriate pauses and emphasis, correct pronunciation, variations in word order, using present, perfect, and future tenses.
1	Apply commonsense understanding to carry out simple one- or two-step instructions. Deal with standardized situations with occasional or no variables in or from these situations encountered on the job.	Add and subtract two digit numbers. Multiply and divide 10's and 100's by 2, 3, 4, 5. Perform the four basic arithmetic operations with coins as part of a dollar. Perform operations with units such as cup, pint, and quart; inch, foot, and yard; and ounce and pound.	Reading: Recognize meaning of 2,500 (two- or three-syllable) words. Read at rate of 95-120 words per minute. Compare similarities and differences between words and between series of numbers. Writing: Print simple sentences containing subject, verb, and object, and series of numbers, names, and addresses. Speaking: Speak simple sentences, using normal word order, and present and past tenses.

[1] Examples of rational systems are: bookkeeping, internal combustion engines, electric wiring systems, house building, nursing, farm management, and navigation.

FIGURE 6-3 Continued

Level	*Time*[4]
1	Short demonstration only
2	Anything beyond short demonstration up to and including 30 days
3	Over 30 days up to and including 3 months
4	Over 3 months up to and including 6 months
5	Over 6 months up to and including 1 year
6	Over 1 year up to and including 2 years
7	Over 2 years up to and including 4 years
8	Over 4 years up to and including 10 years
9	Over 10 years

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[4] Time spent in general educational development is not considered in estimating specific vocational preparation.

FIGURE 6-4 Scale for specific vocational preparation (SVP). Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:220).

and seven environmental conditions. Physical demands were (1) strength (lifting, carrying, pushing, and/or pulling), (2) climbing and/or balancing, (3) stooping, kneeling, crouching, and/or crawling, (4) reaching, handling, fingering, and/or feeling, (5) talking and/or hearing, and (6) seeing. Environmental conditions were (1) work location, (2) extreme cold with or without temperature changes, (3) extreme heat with or without temperature changes, (4) wetness and/or humidity, (5) noise and/or vibration, (6) hazards, and (7) atmospheric conditions.

The analyst indicated simply the presence or absence of physical demands 2 through 6 and environmental conditions 2 through 7. Strength was rated according to one of five levels to reflect sedentary, light, medium, heavy, or very heavy work. Work location was rated to indicate whether the job was performed primarily indoors, outdoors, or both. Many of these factors could have been measured objectively. Because analysts did not take thermometers, decibel meters, or other instruments and gauges with them on site—in fact, as was mentioned previously, they

G	Intelligence	K	Motor Coordination
V	Verbal	F	Finger Dexterity
N	Numerical	M	Manual Dexterity
S	Spatial	E	Eye-Hand-Foot Coordination
P	Form Perception	C	Color Discrimination
Q	Clerical Perception		

Quintiles for Rating Aptitudes

1. *The top 10 percent of the population.* This segment of the population possesses an extremely high degree of the aptitude.
2. *The highest third exclusive of the top 10 percent of the population.* This segment of the population possesses an above average of high degree of the aptitude.
3. *The middle third of the population.* This segment of the population possesses a medium degree of the aptitude, ranging from slightly below to slightly above average.
4. *The lowest third exclusive of the bottom 10 percent of the population.* This segment of the population possesses a below average or low degree of the aptitude.
5. *The lowest 10 percent of the population.* This segment of the population possesses a negligible degree of the aptitude.

FIGURE 6-5 Aptitude factors and rating scale. Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:233).

D	DCP (*d*irection, *c*ontrol, and *p*lanning)
F	FIF (*f*eelings, *i*deas, or *f*acts)
I	INFLU (*influ*encing)
J	SJC (*s*ensory or *j*udgmental *c*riteria)
M	MVC (*m*easurable or *v*erifiable *c*riteria)
P	DEPL (*de*aling with *p*eop*l*e)
R	REPCON (*rep*etitive, *con*tinuous)
S	PUS (*p*erforming *u*nder *s*tress)
T	STS (*s*et limits, *t*olerances, or *s*tandards)
V	VARCH (*var*iety and *ch*ange)

FIGURE 6-6 Temperament factors. Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:295).

1*a*.	A preference for activities dealing with things and objects.	*vs.*	1*b*.	A preference for activities concerned with the communication of data.
2*a*.	A preference for activities involving business contact with people.	*vs.*	2*b*.	A preference for activities of a scientific and technical nature.
3*a*.	A preference for activities of a routine, concrete, organized nature.	*vs.*	3*b*.	A preference for activities of an abstract and creative nature.
4*a*.	A preference for working for the presumed good of people.	*vs.*	4*b*.	A preference for activities that are carried on in relation to processes, machines, and techniques.
5*a*.	A preference for activities resulting in prestige or the esteem of others.	*vs.*	5*b*.	A preference for activities resulting in tangible, productive satisfaction.

FIGURE 6-7 Interest factors. Source: *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972:317).

were often prohibited by employers from doing so—these ratings too were based on analysts' judgments. The analyst queried workers closely about the processes, machines, and materials they worked with in order to determine environmental conditions. To assess physical demands, job tasks were usually merely observed.

COMPLETING AN ESTABLISHMENT STUDY

After completing the establishment staffing schedule, organization and process flow charts, and job analysis schedules for each of the jobs being analyzed in the establishment, the analyst summarized the study in a narrative report. As its title implies, the narrative report is essentially descriptive. Although there is no prescribed format for writing these reports, the *Handbook* (p. 59) suggests that they be organized to include information on (1) the purpose and history of the establishment and the scope of the job analysis study, (2) environmental conditions, (3) the organization and operations or activities of the firm, and (4) its personnel policies and practices.

As the study proceeded or at its completion, the analyst submitted the materials produced to either a lead analyst or the field center supervisor for review. Once the study had been checked and approved, the analyst often sent a note of appreciation to the employer and, depending on the field center's practice, either gave the employer a copy of all materials or provided copies on request.

MODIFICATIONS OF PROCEDURES

The steps described above for conducting an establishment study were in effect during the normal course of fourth edition production and reflect standard operating procedures. During certain periods of production, however, and sometimes in the normal course of events these procedures were modified.

Several years prior to the anticipated publication of the fourth edition, national office staff decided that in order to increase coverage and expedite the production process, modifications to traditional operating procedures were necessary. From 1974 to 1976, analysts were directed to concentrate their efforts on verifying jobs against existing job schedules for similar jobs in other establishments or against the DOT definition if the job could be converted to a third edition code. In this way much of the time-consuming writing entailed in completing the job analysis schedule was eliminated. Evidently, this directive was variously interpreted by the field centers. Analysts at some field centers continued to produce job analysis schedules according to *Handbook* procedures, which require a complete study of the job being verified; others resorted to shortcuts, telephoning an establishment or trade association, for example, in order to verify descriptions of jobs being analyzed in other establishments or to confirm a third edition definition. When this procedure was followed, staffing schedules were not produced.

At about the same time that the directive to change the standard procedure was issued, field centers were also asked to review the status of their industry assignments. As part of this review, field centers submitted lists of jobs (primarily unanalyzed third edition jobs) in their assigned industries that they had been unable to analyze. All such jobs were compiled in a so-called Not Available and Obsolete (NA&O) list that was then circulated among the field centers. Field center staff were requested to try to locate and analyze those jobs on the list that were available in their region; to do so, a complete establishment study was not required. Thus most of the jobs on the list were picked up piecemeal, analysts often entering an establishment to analyze one or two jobs rather than the entire company or a division within it. Again, in this circumstance, staffing schedules were rarely produced.

These changes in procedure—verification and NA&O—were instituted under the pressure of an approaching deadline. Many analysts reported that these pressures resulted in a drop in the quality of the studies and schedules produced during this period. The modifications, however,

TABLE 6-3 Definition Writing Assignments

Center	Occupation Category	Percentage of Base Titles
California, national office	0-1	12
New York	2	8
Florida	3	4
Washington State	4	2
North Carolina	5-9	74
TOTAL	–	100

appear to have had the intended effect of increasing the quantity of jobs analyzed: Booz, Allen & Hamilton, Inc. (1979) reports that 30 percent of the schedules supporting the fourth edition were produced during the 1974–1976 period in which these procedures were in effect.

Finally, no attempt was made to observe certain types of jobs, including some professional jobs, seasonal jobs, and jobs involving a wide variety of tasks spread over long periods of time. The methodology used by the occupational analysis program, because it relies heavily on the direct observation of jobs to collect information about them, is not feasible for the analysis of such jobs on site. Instead, analysts contacted trade and professional associations, employers, or industry representatives for information. On the basis of information obtained from these sources, job analysis schedules were completed in the usual manner.

DEFINITION WRITING FOR THE DOT

The job analysis schedules produced from 1965 to 1976, intended for use in compiling the fourth edition, were filed in the North Carolina field center by third edition DOT code, along with all the other materials resulting from establishment studies. Definition writing was not an ongoing process, and fourth edition definitions were written during 1976, the year preceding publication. (The *Definition Writer's Manual*, a technical manual to assist in this process, was issued a little more than a year earlier, in November 1974.) The national office assigned definition writing to the field centers by occupational categories (see Table 6-3). As is readily apparent, the North Carolina field center wrote the major portion of the DOT: 74 percent of the base title definitions.

FACTORS	JOB A	JOB B	JOB C	JOB D	JOB E	JOB F
Objective						
Worker Function						
Work Field(s)						
MTEWA						
MPSMS						
GED						
SVP						
Aptitudes						
Temperaments						
Interests						
Phy. Demands						
Environ. Condi.						
Education						
Training						
Experience						
OGA Code						

FIGURE 6-8 Worksheet for definition writing.

In order to write definitions, analysts were provided with all the source materials available for the occupations in their assigned categories, which consisted primarily of job analysis schedules. For some titles there were also occupational code requests (job descriptions submitted to the Employment Service for coding to the DOT); copies of third edition definitions; and materials from trade associations, employers, or unions. An analysis of fourth edition source data, discussed in detail in chapter 7, reveals that the material available for each occupation varied greatly in both quantity (from zero to hundreds of job analysis schedules) and quality (from complete job descriptions to the notation "same as third edition").

Analysts wrote definitions according to procedures contained in the *Definition Writer's Manual* (U.S. Department of Labor (1974), hereafter referred to as the *Manual*). Definition writing involved four basic steps, each of which is discussed below: (1) evaluation of source data, (2) identification of related jobs for possible combination to form an occupation, (3) classification and rating of the occupation, and (4) definition writing.

In step 1, if more than two or three source documents were available, analysts usually made up a worksheet (see Figure 6-8) to organize and array the data for easy inspection. At this point, the *Manual* (p. 6) advises analysts to "correct ratings that are clearly in error." The meaning and basis for assessing "error" are not spelled out, but, apparently, analysts were permitted to use their judgment to ensure that the job descriptions in the source data supported the ratings assigned. Since guidelines for determining error were not provided, the analyst writing the composite definition appears to have had a great deal of discretion in assessing and overriding the field work of other analysts.

In step 2, source data were combined. The primary basis for doing so was "common work objective, work field, similarity of tasks, and the level of skill and responsibility involved (worker functions)" (*Manual*, p. 6). Jobs with the same first three digits of the preliminary DOT code and the same work fields and/or generic titles were likely candidates for combination. Analysts were also advised to check jobs in parallel occupational divisions or groups to locate jobs for possible combination, for example, jobs in division 56 (processing of wood and wood products) with jobs in division 66 (wood machining).

Although combined jobs did not have to be identical, they were supposed to be similar. With regard to worker functions in relation to data, people, and things, for instance, the *Manual* (p. 7) offers the following guidelines:

> Any decision to combine jobs of three points difference or more should be reviewed carefully, for if the ratings assigned to the source data are correct, a range of as much as three points difference for a significant worker function would likely mean that the source data are not sufficiently similar to warrant combination.

Similarly, with regard to GED, SVP, and other worker traits the *Manual* emphasizes that jobs should be combined only if their ratings are very similar. Instructions about GED (p. 8), for example, advise that

> Usually the GED level (of combined jobs) should be the same. However, because of differences between raters, the strong influence of employer requirements (which may vary from place-to-place and with supply of labor), and problems of rating borderline situations, a difference of one level but rarely two may be considered for combination when the other factors (especially SVP and aptitudes) support the decision.

Thus in deciding to aggregate jobs to form occupations, analysts used no single criterion. Analysts made the initial determination on the basis of the jobs' preliminary DOT codes and titles and then took account, within fairly narrow guidelines, of worker traits and the particular relationships among them.

Having decided how data about individual jobs would be combined, in step 3 analysts assigned the occupation its DOT code and rated it for worker traits according to instructions in the *Handbook*. Because "erroneous" ratings had already been corrected and because jobs were aggregated on the basis of the similarity of their worker trait ratings, there should have been little within-occupation variation on each of these traits. Presumably, then, the rating was straightforward. Analysts appear to have eyeballed the raw data and chosen the most frequently occurring level for each trait (i.e., the modal value) rather than to have calculated other measures of central tendency (mean or median). As our analysis of the reliability of ratings in the next chapter shows, however, there appears to be rather more variability among job descriptions combined to form occupations than would be expected from this description of procedures.

In step 4, which involved writing the actual definition, analysts drew most heavily on information contained in the job summary and description of tasks on the job analysis schedule. If a third edition title could be used, it was, as was its definition, with modification as required. Definitions were written according to the structured format described in chapter 2. In defining an occupation, analysts described its important tasks in detail, with particular emphasis on "responsibilities and requirements imposed upon the worker" (*Manual*, p. 38).

Significant worker functions were also supposed to be reflected in the definition, but worker traits did not have to be referred to directly unless they were especially pertinent to job performance. The *Manual* (p. 56) does counsel, however, that a "relationship must be maintained between the trait rating and the definition. For example, if temperament factor J (JUDGMENT) was rated, some indication should appear in the definition that describes the nature of the judgment required."

Definitions were sent to the North Carolina field center, where they were reviewed by teams of analysts selected by the national office from each of the field centers. Review teams worked for a week at a time and attempted to review as many definitions as were available. Definitions written by one field center were reviewed by analysts from another. Aside from this restriction, analysts chose which occupations they would review and were not required to be particularly knowledgeable about them. Reviewers were permitted to make changes in the definitions they reviewed; changes from the third edition definition, however, had to be specially justified on an occupational definition transmittal form (used to record the final definition approved for the fourth edition). According to analysts involved in definition writing, reviewers were quite conservative and resistant to incorporating changes in existing third edition definitions. This claim is borne out by the Booz, Allen & Hamilton study. According to results from a random sample of 307 DOT base title occupations, 81 percent of fourth edition definitions were identical to those in the third edition.

CONCLUSION

Results from our field center site visits, coupled with inspection of the technical manuals used to assist analysts in the production of the DOT, lead us to certain general impressions about this process.

First, instructions about how to study jobs appear to have been insufficient and inadequate. Major steps in the job analysis process did not have sufficient guidance (e.g., establishment selection). Furthermore, the manual of basic data collection procedures, the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972), was not published until midway through production of the fourth edition. In the absence of clear, explicit instructions, decisions about major aspects of data collection were left entirely up to individual field centers and analysts. Although there appears to have been surprising uniformity among field centers in the way they conducted job analysis studies and fulfilled their industry assignments, there was certainly room for considerable variation, which may have adversely affected the quality and comparability of the data collected.

Second, procedures used to produce the DOT were insufficiently documented. For virtually every step in the production process, there was little or no information available about the criteria used in decision making or how a particular decision had been reached. Not only did this lack of documentation make it difficult to determine what was actually done, but also it means that nothing is known—or easily found out—about the sampling properties, quality, and characteristics of the resulting data. The indeterminate nature of the data potentially compromises the usefulness of the DOT.

Third, production of the DOT was poorly planned and coordinated. The modified procedures implemented prior to publication reportedly resulted in job analyses of lower quality than those produced during the period when standard procedures were in effect. (This conclusion is discussed in chapter 7.) Definitions were written especially hurriedly, with the likely result that source data were not fully explored or perhaps evenly and consistently aggregated or combined.

Fourth, considering the procedures followed, there is some question as to whether, in developing material for the fourth edition, adequate coverage was obtained of newly emerging industries and occupations. The previous edition served, in effect, as the sampling frame for the fourth edition. Industries were assigned by using the third edition industry designations, and a major portion of the total data collection effort was spent trying to verify or update third edition occupations. These practices were efficient in some ways, but they were also rather conservative, minimizing the probability of incorporating newly emerging jobs in the DOT or of picking up changes in existing jobs. They may also have perpetuated the flaws, if any, of the previous edition. Furthermore, by relying on the third edition, little effort seems to have been made to explore the possibility of developing new or better sampling strategies. Data are available on industries and establishments at the local and national levels, for example, that might have been exploited to assign industries to field centers more systematically and to aid in the selection of establishments at the regional level.

Fifth, no attempt was made to develop new job analysis methodology or to adapt existing methods to deal with a changing occupational structure. Although the methodology used provides a standardized and relatively objective means of obtaining job data, it is time consuming and not suitable for all jobs. In particular, it can be applied most practically to manufacturing jobs or, more generally, to any type of structured job that can be broken down into discrete tasks and performed over a limited amount of time. It is less suited to unstructured jobs, such as certain service jobs that entail widely varying tasks. The lack of a well-developed method for analyzing jobs that are not amenable to the usual procedures may have impaired the DOT's coverage of these jobs as well as the comparability of the resulting data for different types of jobs, especially structured versus unstructured ones. Existing alternative job analysis methodologies, such as task inventories and structured job analysis, should be explored in an effort to improve the consistency of job analysis and to delineate the boundaries of occupations more precisely. See McCormick (1979) and Prien and Ronan (1971) for recent summaries and reviews of these approaches.[1]

These points raise a number of questions about the quality and characteristics of the data on which the DOT is based, in particular, the following: Were industries and jobs adequately covered? Are the data valid and reliable? To what extent did variations in procedures across field centers and analysts introduce bias and lack of comparability into the resulting data? What is the distribution of the occupational characteristics data (worker functions and worker traits)? What are the interrelationships among them? These questions and others are systematically addressed, to the extent possible given the data available to do so, in chapter 7.

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[1] The California field center produced a collection of task analysis inventories in 1973. This collection was designed to be used as an aid in job analysis, to substitute an abbreviated data collection process for the standard procedure, and to provide guidelines for those not trained in job analysis.

7 An Assessment of the *Dictionary of Occupational Titles* as a Source of Occupational Information

INTRODUCTION

In the preceding chapter, procedures used to compile the most recent edition of the *Dictionary of Occupational Titles* are described, and several concerns are raised about the quality and characteristics of the fourth edition in light of the way it was produced. To fulfill the committee's charge to make recommendations about whether future editions of the DOT should be produced and what kinds of occupational research should be conducted to produce them, an evaluation of the quality and characteristics of the DOT is presented in this chapter. The results of this assessment, coupled with knowledge about use, have helped to inform us as to how well the data contained in the DOT meet the purposes for which they are intended and/or used. This assessment is also a basis for the committee's recommendations about whether data collection and analysis activities used in compiling future editions of the DOT should differ substantially from what has been done in the past.

Establishing the quality and characteristics of data contained in the DOT is not a straightforward task. First, as already mentioned, data collection procedures were not well documented. As a result the possibilities are

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Pamela S. Cain had primary responsibility for the preparation of this chapter.

limited for systematic secondary analysis of the procedures themselves or of their implications for the resulting data. Second, most of the data contained in the DOT are unique, so no readily available bench marks exist against which to compare and assess them. In fact, a great deal of occupational research takes the DOT as the bench mark or standard of comparison, a fact that makes the assessment of DOT data even more important. In this chapter we present the results of several analyses that were designed to explore in detail and systematically the nature of the process by which the DOT was produced and the quality and characteristics of the resulting data.

SAMPLING PROCEDURES

As described in chapter 6, the industry designations developed by the occupational analysis program provide the "sampling frames" from which establishments are selected for on-site visits. The underlying assumptions of the procedure are that jobs vary by industry, by region, and by size (i.e., number of employees) and that these criteria provide the soundest basis for achieving reasonable coverage of all jobs and for discovering significant variations among jobs within occupations. Within the establishments chosen, emphasis is put on analyzing those jobs that appear to be unique to the work performed in establishments of the type that the selected one represents.

No bench mark data on the "population" of jobs exist, and the procedures by which specific choices were made about which jobs to study are not well documented. Consequently, it is not possible to establish whether the DOT provides comprehensive and representative information about jobs in the U.S. economy. Nevertheless, certain aspects of the procedures and their outcomes raise serious questions about the success in attaining representative coverage.

A total of 232 industry designations are used to delineate the "universes" from which sample establishments are chosen. As we have noted in chapter 2, several of these, notably the designation clerical and kindred workers, are not in fact industries, and their use carries the implicit assumption that such occupations do not vary significantly in content among establishments of different types. As a consequence of this treatment of a number of nonproduction occupations the majority of the 232 industry designations that provide the universes from which establishments are selected are in the manufacturing sector. In contrast, the current version of the *Standard Industrial Classification* denotes 1,005 industries at its most detailed level, and less than half are in manufacturing. Viewed in this context then, the DOT cannot be said to be based on job analyses conducted in establishments representing the entire spectrum of U.S. industry types.

Comparable establishment-level data for the DOT and the U.S. economy can be used to yield a crude indicator of the direction in which the job analysis efforts for the fourth edition DOT were channeled. In themselves these data do not constitute an evaluation of the DOT's coverage, since the critical issue, under the assumptions of the procedure currently used, is the variety of types of establishments rather than the number of establishments (or the number of employees). Nevertheless, comparison of the two distributions reinforces the impression of a disproportionate emphasis on manufacturing.

Data for DOT establishments were obtained from a set of staffing schedules that were recently computerized and made available to us by the national office of the Division of Occupational Analysis. As noted in chapter 6, in the course of fourth edition production, staffing schedules were not prepared for all establishments entered or for all jobs analyzed. Furthermore, computerization of the schedules had not yet been completed at the time of the committee's study. Thus the data employed in our analysis cover only 2,063 establishments; schedules for an estimated 1,100 to 1,200 establishments are still outstanding.[1]

The characteristics of establishments in which staffing schedules were not completed or of establishments whose schedules had not yet been computerized cannot be determined. As far as we can ascertain, there is no reason to believe that there are marked differences between the characteristics of establishments for which data are and are not available, especially since analysts were supposed to complete staffing schedules for every establishment in which they analyzed a significant number of jobs. Given the procedures by which staffing schedules were filled out and their purpose, however, we conjecture that analysts may have been more likely to complete the schedules in larger, more bureaucratic establishments, especially those with personnel offices.

Data on the national population of establishments were obtained from tables in *County Business Patterns, 1974* (U.S. Bureau of the Census, 1977). This publication is compiled by the Census Bureau using data from the administrative records of the Internal Revenue Service and the Social Security Administration. Information is available on establishments, payroll, and employment by industrial classification, size class, and county for all types of employment covered by the Federal Insurance Contributions Act. In 1974 these data covered approximately 90 percent of U.S.

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[1] This information was obtained through personal communication with staff at the national office and the North Carolina field center.

establishments and 75 percent of the employed population. Not covered were some government employees; self-employed persons; and certain types of farm, domestic service, and railroad workers.

In order to compare the DOT data with the published data on the national population of establishments, the staffing schedules were recoded to the categories used in *County Business Patterns*. The DOT establishments in public administration ($N = 59$) were excluded from tabulations, as were establishments for which data were missing. These exclusions resulted in the loss of 113 establishments and a final total of 1,950 establishments in the DOT sample.

Table 7-1 presents a comparison of the percentage distribution of DOT and U.S. establishments by SIC major industry division. The two distributions exhibit marked dissimilarities. The largest discrepancy occurs in the manufacturing category: 67 percent of the DOT establishments are in manufacturing industries, although this category accounts for only 8 percent of all U.S. establishments and for 32 percent of total employment.

Underrepresentation is most pronounced in the retail trade and services divisions. Retail trade accounts for a mere 4 percent of the DOT establishments, although nationally, it includes 29 percent of establishments and employs 20 percent of the labor force. Only 7 percent of the DOT establishments are in the services division, an industry division that accounts for 27 percent of all U.S. establishments and for 20 percent of U.S. employment. Both retail trade and services include establishments engaged in a great variety of activities. It seems highly improbable that the disparity in coverage between these major industry divisions and the manufacturing division reflects a real difference in the heterogeneity of occupations.

As previously noted, the wide disparity between the two distributions cannot be interpreted as conclusive evidence; but it does suggest that the procedures used to select establishments for the fourth edition DOT resulted in an overrepresentation of establishments in manufacturing industries. This overrepresentation occurred primarily at the expense of the retail trade and service industries, which include 40 percent of all workers. Moreover, the comments and observations of field center personnel lend additional support to the general impression that job analysis activities have tended to place emphasis on manufacturing industries.

Size was another important criterion of establishment selection according to the occupational analysts, one for which national data are also available from *County Business Patterns, 1974* (U.S. Bureau of the Census, 1977). In Table 7-2 the percentage distribution of establishments by size class (number of employees) is presented for the DOT and for the U.S.

TABLE 7-1 Percentage Distribution of Establishments by SIC Industry Division: Comparison of DOT Sample[a] and U.S. Labor Force[b]

SIC Division	Establishments			U.S. Labor Force,[c] percentage
	DOT, N	DOT, percentage	U.S., percentage	
Agricultural services, forestry, fisheries	161	8.3	0.9	0.3
Mining	27	1.4	0.6	1.1
Contract construction	52	2.4	9.1	6.2
Manufacturing	1,309	67.2	7.6	32.1
Transportation and utilities	95	4.9	3.5	6.4
Wholesale trade	40	2.1	8.7	7.0
Retail trade	82	4.2	29.0	19.6
Finance, insurance, real estate	44	2.3	9.0	6.8
Services	140	7.2	26.8	19.6
Nonclassifiable[d]	0	0.0	4.8	0.9
TOTAL	1,950	100.0	100.0	100.0

[a] DOT data taken from establishment staffing schedules. For purposes of comparison with U.S. data, establishments in public administration were eliminated from tabulation.

[b] SOURCE: *County Business Patterns, 1974* (U.S. Bureau of the Census, 1977: Table 1B).

[c] Workers employed in the establishments covered, not the employed civilian labor force.

[d] Included in this category are establishments that could not be classified because of insufficient information. Typically, these were new businesses.

population of establishments. This comparison also reveals discrepancies between the DOT sample and the national population; the discrepancy is particularly large in the smallest size class. Establishments employing one to four workers made up 59 percent of all U.S. establishments but only 6 percent of the DOT establishments. Generally, small establishments with fewer than 20 employees were underrepresented in the DOT sample, while intermediate (20 to 249 employees) and large (250 or more employees) establishments were overrepresented in relation to the U.S. distribution of establishments. There is a rather close correspondence, however, between the DOT distribution of establishments and the distribution of U.S. employment.

Once again, we point out that the implications of these results for the

TABLE 7-2 Percentage Distribution of Establishments by Employment-Size Class: Comparison of DOT Sample[a] and U.S. Labor Force[b]

	Establishments			
Size	DOT, *N*	DOT, percentage	U.S., percentage	U.S. Labor Force,[c] percentage
1-4	125	6.4	58.7	7.2
5-9	149	7.6	18.0	8.2
10-19	200	10.3	11.3	10.4
20-49	367	18.8	7.5	15.3
50-99	277	14.2	2.4	11.4
100-249	338	17.3	1.4	13.6
250-499	216	11.1	0.4	9.6
500-999	120	6.2	0.2	8.3
1,000+	158	8.1	0.1	16.0
TOTAL	1,950	100.0	100.0	100.0

[a] DOT data taken from establishment staffing schedules. For purposes of comparison with U.S. data, establishments in public administration were eliminated from tabulation.
[b] SOURCE: *County Business Patterns, 1974* (U.S. Bureau of the Census, 1977: Table 1B).
[c] Workers employed in the establishments covered, not the employed civilian labor force.

coverage of jobs are not straightforward. If the assumption that industry type is the proper basis for sampling establishments is correct, then an important first step might be to revise the industry list so that it provides coverage of all unit items in the SIC. In this frame of reference the number of establishments in each industry would not be relevant, since the objective would be to obtain adequate minimum coverage for each separate type of establishment. On the other hand, if jobs in manufacturing are more diverse than those in other sectors, then oversampling of manufacturing enterprises is quite appropriate. The DOT analysts would be expected to devote more of their attention to establishments (and presumably jobs) in these industries. Furthermore, if jobs tend to be similar in large and small establishments, undersampling small establishments and oversampling large estabishments would be justified on grounds of cost effectiveness.

The difficulty is that there is no evidence at all regarding the relationship between type of establishment and the variability of job content. We do not know whether manufacturing jobs are more heterogeneous than other jobs or whether jobs in small establishments differ from ostensibly similar jobs in large establishments or in other small establishments.

In addition to considering the types and sizes of establishments providing the base data for the DOT, it is also possible to compare the distribution of occupational units in the DOT with the distribution of workers. This approach also has very obvious limitations, since some occupational units include large numbers of workers and others include relatively few. Nevertheless, the data presented in Table 7-3, in which DOT coverage and labor force employment by major occupational category are shown, reveal very marked discrepancies. Some 60 percent of all base titles fall in the processing, machine trades, and benchwork categories, although these categories include only about 12 percent of the labor force. Taken in conjunction with the finding (documented in Table 7-5 below) that a substantial proportion of occupational titles are supported by one (or no) job analysis schedule, the skewness of the distribution in Table 7-3 raises the conjecture that the choice of jobs for analysis has a major impact on the number of occupations identified and that therefore the concentration of attention on manufacturing establishments has an important impact on the entire classification structure. To state this more explicitly, if there is a strong tendency for each job analysis to result in the identification of a separate occupation (as Table 7-5 seems to imply), the selection of job analysis sites and of the jobs to be analyzed at these sites becomes the crucial decision of the occupational analysis program.

As noted above, the procedures for selecting sites for job analysis were not carefully developed. Analysts drew heavily on the third edition DOT to guide their job analysis activities. This practice might well have led them to concentrate more on jobs in established manufacturing industries (which were well represented in earlier editions) and to devote less attention to jobs in newly emerging or rapidly growing sectors of the economy, such as services or retail trade. In addition, it was clear to us in talking with the analysts that many were oriented almost exclusively toward the study of production jobs. Undoubtedly, this orientation is a historical outgrowth of the program, rooted in tradition, but other reasons may be salient, such as the ease of access to manufacturing establishments. Similarly, the emphasis on large establishments may have come about because of the relative efficiency of analyzing many jobs in a few large establishments versus a few jobs each in many small ones.

For whatever reasons the concentration on manufacturing and relatively large establishments came about, and whatever its implications are for the coverage of jobs, the results of the foregoing comparisons raise questions about exactly how sampling for the DOT should proceed. Previous practices were relatively unsystematic, virtually uninformed by empirical

TABLE 7-3 Comparison of Percentage Distributions of DOT Titles and Labor Force by DOT Occupational Categories

DOT Occupational Category	Percentage of Base Titles ($N = 12{,}099$)	Percentage of Labor Force
Professional, technical, and managerial	12	25
Clerical and sales	8	25
Service	4	16
Agriculture, fishing, and forestry	2	4
Processing	23	2
Machine trades	18	6
Benchwork	19	4
Structural work	7	9
Miscellaneous	7	8
TOTAL	100	99

SOURCE: Labor force data derived from April 1971, Current Population Survey; sample ($N = 60{,}441$) includes currently employed workers and experienced unemployed for whom a census code could be assigned. Excluded are 12 percent of sample for whom DOT codes could not be assigned. Data on distribution of DOT titles by category provided by the Department of Labor occupational analysis program.

data, and resulted in relative inattention to several sectors that include large proportions of workers. The distributions of workers or of establishments that we have had to use as crude indicators are not the basic relevant criteria, of course; a more desirable goal would be the identification of the types of organizations that have unique types of jobs, with at least minimum coverage of these unique types of jobs.

A sampling strategy that would ensure adequate coverage of the job content of the American economy will not be easy to develop, but it is essential that work on this problem be initiated immediately if the DOT is to serve the many demands that are made of it.

SOURCE DATA

Chapter 6 observes that the amount and type of source data supporting DOT titles and definitions vary and that the quality of the data appears to be uneven. These conclusions were based on examination of the source data, on reports from analysts involved in writing definitions, and on findings of the Booz, Allen & Hamilton, Inc. (1979) management review. In this section a more systematic and detailed inquiry into the quality of source data is undertaken to determine the extent to which departures from standard procedures occurred and whether such departures vary by period or across certain types of jobs. As is evident from the discussion in chapter 6, there are numerous points at which departures could have occurred. The nature of these departures is important to the extent that they have deleteriously affected the quality and comparability of the data in the DOT.

To assess the quality of DOT documentation, we used a set of data collected by Booz, Allen & Hamilton as part of its management review. Because the only information available on the procedures by which the DOT was produced is anecdotal and impressionistic, Booz, Allen & Hamilton conducted a special study of DOT source data in November 1978. Analysts at the North Carolina field center were requested to record information on the documentation available for a sample of 307 DOT base titles. The sample was systematically selected by choosing every fortieth title in the DOT. However, there was an occasional departure from this procedure. If the title selected was not a base title, a substitution was made, but the procedure by which this was done is unclear.

Even though the sample is slightly unsytematic, the difficulties of conducting another similar study justify the use of these data to get an idea of the quality of DOT documentation. As a check on the Booz, Allen & Hamilton sample, the percentage distribution of base titles by DOT major occupational categories for the sample was compared with that of the DOT. The comparison, in Table 7-4, reveals that the two distributions are very similar. Hence on this criterion at least, the sample appears to be quite representative of the population from which it was drawn.

The distribution of DOT titles by the kind of documentation available for each is shown in Table 7-5. The summary information at the end of the table shows that 11 percent of the DOT titles had no supporting documentation other than the third edition definition, which was based on job analyses conducted prior to 1965. Seventy-one percent of titles were supported by job analysis schedules only, 8 percent by schedules and occupational code requests, and the remaining 10 percent by other combinations of data. Thus job analysis schedules constituted the bulk of the data base for the DOT, other types of information making up a relatively small percentage of the source data.

The quality of the definitions for the 11 percent of titles lacking any sort of documentation other than the third edition is particularly questionable, since there is no way of knowing whether and to what extent changes in the content of these jobs occurred between the third and fourth editions. The quality of definitions based solely (5 percent) or in part (14 percent) on information other than job analysis schedules may also be questionable.

TABLE 7-4 Percentage Distribution of DOT Titles by Major Group: The DOT versus the Booz, Allen & Hamilton Sample

Category	DOT	Booz, Allen & Hamilton Sample
0-1	12	13
2	8	9
3	4	5
4	2	1
5	23	21
6	18	18
7	19	19
8	7	8
9	7	6
TOTAL	100	100
N	(12,099)	(307)

Occupational code requests, for example, are essentially employers' job orders, which are taken over the phone and may not be verified on site. As a result the job specifications contained in code requests probably reflect hiring requirements rather than the functional requirements of jobs, as would have been determined via on-site analysis. Similarly, information obtained through letters from trade associations (which are, in part, advocacy groups) is perhaps more likely to depict the ideal job than the average or typical one. For both sources of information, skill and other requirements of the job may be inflated or biased upward, in relation to what would have been determined through on-site analysis. If these data continue to be used to support DOT definitions, steps should probably be taken to determine their properties and possible biases and their comparability to data obtained via on-site observations and interviews.

Table 7-5 shows the distribution of titles by the number of job analysis schedules available for each. Sixteen percent of DOT occupations are unsupported by job analysis schedules (11 percent of these are completely unsupported, and 4.5 percent are supported by other types of information). Of the total number of occupations an additional 29 percent are supported by only one schedule, 19 percent by two schedules, and the remaining 37 percent by three or more schedules.

The small number of jobs analyzed per title raises additional questions about the inclusiveness and accuracy of the occupational information

TABLE 7-5 Percentage Distribution of DOT Titles by Number and Type of Supporting Documentation

Documentation	Percentage
Number of job analysis schedules (JAS)	
0	16
1	29
2	19
3	8
4	7
5	3
6	4
7	2
8+	13
TOTAL	101
Number of occupational code requests (OCR)	
0	90
1	6
2	2
3+	2
TOTAL	100
Number of other[a] sources	
0	89
1	8
2	2
3+	1
TOTAL	100
All forms of documentation	
None	11
JAS only	71
OCR only	1
Other only	4
JAS and OCR	8
JAS and other	5
JAS, OCR, and other	1
TOTAL	101
TOTAL *N*	307

[a] Other includes comments from trade associations, job descriptions from employees, etc.

SOURCE: Tabulated using data from Booz, Allen & Hamilton study of DOT documentation.

contained in the DOT. The DOT definitions purport to be composites of the content of jobs that can be grouped together under a single occupational title—not average or representative in the statistical sense, but rather typical. Granted that this claim is a vague one, there is still reason to question it, for 64 percent of fourth edition DOT titles are based either solely on a single third edition definition (which appears not to have been verified for the fourth edition) or on the new analysis of only one or two jobs. If jobs within an occupational composite are very similar (i.e., if the occupation is homogeneous), then a small number of observations per occupation may be sufficient to define it accurately. If, on the other hand, there is a good deal of variation among the jobs making up an occupation (e.g., differences in job tasks or in technologies or materials), then a larger number of observations is probably desirable in order to capture adequately the occupation's core tasks and its significant variations.

Unfortunately, for the majority of occupations in the DOT there is insufficient information to determine whether an occupation is homogeneous (so as to require few job analyses) or heterogeneous (requiring numerous analyses). Assuming that some occupations vary in their constituent jobs, it would seem advisable to explore further this issue of job or occupational heterogeneity in order to determine the optimal number of analyses needed to obtain reliable and adequately representative occupational information. This might be done by analyzing the existing source data for those DOT titles that are based on multiple job analyses or by undertaking intensive new analyses of numerous jobs in the same occupation (see Appendix E for a limited analysis of this kind).

An inquiry into the characteristics of job analysis schedules shows that they too vary in several respects that might affect the quality of the DOT's occupational composites. Table 7-6 gives the distribution of schedules by treatment type, the procedures by which they were produced, and quality. This table and the next one are based on the 1,351 schedules contained in the files of the Booz, Allen & Hamilton sample of 307 DOT occupations. As Table 7-6 shows, the majority of schedules available for the fourth edition (66 percent) are C schedules, in which the job description is abbreviated to include only variations from the third edition definition. A schedules, which were prepared for jobs that could not be converted to a third edition code and thereby contained full job descriptions, constitute 26 percent of all schedules. V schedules, in which the job description is abbreviated to include only variations from descriptions in other schedules, make up 8 percent of the total.

In accordance with *Handbook* procedures (U.S. Department of Labor, 1972), almost all schedules (94 percent) were prepared on the basis of direct observation of jobs. Only 6 percent were prepared using data

TABLE 7-6 Percentage Distribution of Job Analysis Schedules by Selected Characteristics for Selected Periods

Characteristic	Total	1962-1965	1966-1973	1974-1976
Treatment type				
A (new job analysis)	26	20	34	13
C (confirmation of occupational definition in previous edition DOT)	66	67	64	69
V (verification of occupational definition based on previous job analysis)	8	13	2	18
TOTAL	100	100	100	100
Direct observation				
No	6	0	1	16
Yes	94	100	99	84
TOTAL	100	100	100	100
Photocopy				
No	86	98	94	70
Yes	14	2	6	30
TOTAL	100	100	100	100
Quality				
Acceptable	66	53	74	60
Unusual MTEWA[a] or MPSMS[b] not described	19	17	18	22
Job did not convert to 3rd edition code and description inadequate	3	4	3	2
Technical terms not defined	0	0	0	0
Other	12	26	5	16
TOTAL	100	100	100	100
Period produced				
3rd edition (1962-1965)	10			
Regular (1966-1973)	57			
Verification (1974-1976)	33			
TOTAL	100			
TOTAL N^c	(1,351)	(128)	(735)	(426)

[a] Machine, tools, equipment, or work aids.

[b] Material, products, subject matter, or services.

[c] Totals for period subgroups do not add to 1,351 because cases with missing data were eliminated.

SOURCE: Tabulated using data from Booz, Allen & Hamilton study of DOT documentation.

obtained through other means such as phone calls or letters. Eighty-six percent of all schedules are original write-ups, while 14 percent are photocopies of other schedules—a shortcut that is not, strictly speaking, acceptable. Sixty-seven percent of all schedules, whether an original or based on direct observation, are acceptable by *Handbook* criteria; i.e., terms are defined and all items were completed. For 19 percent of the schedules, machines, tools, equipment, or work aids (MTEWA) or materials, products, subject matter, or services (MPSMS) are not described, while for another 15 percent the job description is inadequate or various items on the schedule have been omitted.

Table 7-6 also shows the distribution of schedules by the period in which they were produced. The first period (1962–1965) covers third edition production. The second period (1966–1973) is post-third-edition, during which standard operating procedures were in effect. The third period (1974–1976) covers the years immediately prior to publication of the fourth edition, during which abbreviated verification procedures were used. Results indicate that 10 percent of the schedules used in developing the fourth edition were in fact produced for the third edition. The majority, 57 percent, were produced in the 9-year period after publication of the third edition. One third of all schedules were produced in the "verification" period, when abbreviated procedures were implemented in order to speed completion of the fourth edition.

In the verification period (1974–1976), procedures were reportedly much abbreviated. To investigate whether there was a relative lowering of standards during that time and a concomitant decline in quality, the distribution of procedural and qualitative indicators was broken down by period (see Table 7-6). As expected, the percentage of verification (V) schedules increased in this period, from 2 percent of all schedules in 1966–1973 to 18 percent of all schedules in 1974–1976. The production of A schedules for new jobs that were not readily coded to the third edition dropped from 34 to 13 percent. The production of C schedules as a proportion of the total, by contrast, remained fairly constant across all periods.

The results in Table 7-6 document an increase in the proportional incidence of departures from *Handbook* procedures during the 3-year verification period. Whereas 99 percent of all schedules produced in the period prior to verification (1966–1973) are based on direct observation, 84 percent of the schedules dating from the verification period were produced in this way. Thus 16 percent of the schedules dated from the period immediately preceding publication result, not from on-site observation interview but from phone calls to employers, mailed questionnaires, talks with professional and trade associations, etc. The practice of duplicating

TABLE 7-7 Percentage Distribution of Job Analysis Schedules, by Selected Characteristics and Type of Job

Characteristic	Nonmanufacturing	Manufacturing
Treatment type		
A	30	24
C	65	66
V	5	10
TOTAL	100	100
Direct observation		
No	6	6
Yes	94	94
TOTAL	100	100
Photocopy		
No	90	84
Yes	10	16
TOTAL	100	100
Quality		
Acceptable	70	65
Unusual MTEWA or MPSMS not described	14	22
Job did not convert to 3rd edition code and description inadequate	2	3
Technical terms not defined	0	0
Other	14	10
TOTAL	100	100
TOTAL N[a]	(471)	(823)

[a] Total does not add to 1,351 because cases with missing data were eliminated.

SOURCE: Tabulated using data [illegible] Booz, Allen & Hamilton study of DOT documentation.

previous schedules rather than writing up analyses anew also increased proportionally, from 6 percent in the post-third-edition period to 30 percent during the verification period. In interpreting these variations by period it should be borne in mind that the total incidence of departures from *Handbook* procedures across all periods is relatively small, as is shown in Table 7-6. Concomitant with the increase in shortcut procedures, the percentage of acceptable schedules dropped from 74 percent of the total in 1966–1973 to 60 percent in 1974–1976.

Although there is variation by period in the incidence of shortcuts or deviations from accepted procedures, these departures do not appear to have occurred disproportionately for certain types of jobs. Table 7-7 shows the type, procedures, and quality of schedules broken down by two broad categories: manufacturing and nonmanufacturing. The number of cases in the sample did not permit a finer breakdown by job type. The nonmanufacturing category is composed of occupations in DOT categories 0–1 (professional, technical, and managerial), 2 (clerical and sales), 3 (service), 4 (agriculture, fishing, and forestry), and 9 (miscellaneous). The manufacturing category is made up of occupations in DOT categories 5 (processing), 6 (machine trades), 7 (benchwork), and 8 (structural work). The distribution of schedules by treatment type is very similar for both categories, with slightly more verification schedules and fewer schedules for new jobs for manufacturing than for nonmanufacturing. In addition, the distributions on observation are identical: 94 percent of the schedules completed in both categories were based on on-site observation. Schedules for manufacturing jobs, however, are slightly more likely (16 versus 10 percent) than those for nonmanufacturing jobs to have been photocopies of other schedules rather than original write-ups. The quality of manufacturing schedules is also somewhat lower than those for nonmanufacturing jobs: 65 percent of schedules in manufacturing were acceptable, compared with 70 percent of nonmanufacturing schedules. The difference is due primarily to the greater incidence of undefined terms (machines, tools, equipment, or work aids and materials, products, subject matter, or services) for schedules in the manufacturing category.

Although the consequences of departures from standard procedures or of schedules of poor quality cannot be determined with any certainty, the existence of such departures raises doubts about the quality of the occupational definitions in the DOT. Overall, the incidence of shortcuts or deviations is relatively low. Departures did occur disproportionately, however, in the period just prior to publication. If job analysis for the fourth edition had been better planned and paced, it is likely that these departures could have been avoided altogether. To cut down on the incidence of such last-minute departures, better planning of DOT production and an ongoing process of quality control are advisable.

Another concern arising from these analyses deserves further consideration. According to *Handbook* procedures, full job descriptions are not required for schedules of treatment type C (confirming third edition codes) and V (verifying fourth edition descriptions), which, as Table 7-6 shows, account for 74 percent of all fourth edition schedules. In some cases, analysts provided full job descriptions anyway; in other cases, "same as third edition" is the only job description available on a schedule. The description of job duties is perhaps the most important piece of information contained in the job analysis schedule, serving as the basis for the definition itself and as implicit justification for the assignment of a DOT classification code and worker trait ratings. Because of the importance of the description, thought should be given to requiring a full job description on every schedule, regardless of whether the job being analyzed can be converted to a third edition title or is similar to a previously analyzed job. To promote efficiency, some of the items on the schedule or other pieces of information analysts are now required to supply might be eliminated. For example, the narrative report, the process flow chart, and the organization chart, all of which take considerable time to prepare, are apparently almost never used subsequent to their preparation. It would be misguided, however, to abbreviate the most important piece of information on the job schedule: the job descriptions.

In addition, the practice of writing full job descriptions only for jobs that cannot be converted to a third edition code may have hindered the effort to identify new jobs adequately or to update old ones by creating a tendency for analysts to force similarities between the job being analyzed and the third edition definition. The use of different treatment types was devised as a way of eliminating needless effort on the part of analysts, but thought should be given to developing other ways of achieving this end that do not carry with them the potential for adversely affecting the data collected.

RATINGS OF WORKER FUNCTIONS AND WORKER TRAITS

In the course of producing the DOT, analysts assigned scores to jobs (during data collection) and occupations (during definition writing) on a variety of worker functions and worker traits; these procedures are described in chapter 6. Little is known about the validity and reliability of these DOT indicators: what attributes of jobs they actually measure, how accurately they measure them, and how consistent the measurements are. A description of the variables and their scoring is shown in Table 7-8.

VALIDITY

Concern about the validity of the DOT's ratings of worker functions and worker traits arises for a number of reasons. First, the factors represented by this set of variables are vague and ambiguously defined. It is not readily apparent what the variables are intended to measure. Worker functions, for example, are said to "express the total level of complexity of the job-worker situation" (*Handbook*, p. 5), but "complexity" is never defined or further specified. Sidney Fine, who was instrumental in developing the worker functions, has written that they reflect estimates of skill (Fine,

TABLE 7-8 The DOT Occupational Characteristics, Fourth Edition

Variable Label	Description[a]	Scoring
Worker functions		
DATA	complexity of function in relation to data	0 to 6[b]
PEOPLE	complexity of function in relation to people	0 to 8[b]
THINGS	complexity of function in relation to things	0 to 7[b]
Training times		
GED	general educational development	1 to 6
SVP	specific vocational preparation	1 to 9
Aptitudes		
INTELL	intelligence	1 to 4[b,c]
VERBAL	verbal aptitude	1 to 5[b]
NUMER	numerical aptitude	1 to 5[b]
SPATIAL	spatial perception	1 to 5[b]
FORM	form perception	1 to 5[b]
CLERICAL	clerical perception	1 to 5[b]
MOTOR	motor coordination	1 to 5[b]
FINGDEX	finger dexterity	1 to 5[b]
MANDEX	manual dexterity	1 to 5[b]
EYEHAND	eye-hand-foot coordination	1 to 5[b]
COLORDIS	color discrimination	1 to 5[b]
Temperaments		
DCP	direction, control, and planning	0/1
FIF	feelings, ideas, or facts	0/1
INFLU	influencing people	0/1
SJC	sensory or judgmental criteria	0/1
MVC	measurable or verifiable criteria	0/1
DEPL	dealing with people	0/1
REPCON	repetitive or continuous processes	0/1
PUS	performing under stress	0/1
STS	set limits, tolerances, or standards	0/1
VARCH	variety and change	0/1
Interests		
DATACOM	communication of data versus activities with things	−1 to 1[d]
SCIENCE	scientific and technical activities versus business contact	−1 to 1[d]
ABSTRACT	abstract and creative versus routine, concrete activities	−1 to 1[d]
MACHINE	activities involving processes, machines, or techniques versus social welfare	−1 to 1[d]
TANGIBLE	activities resulting in tangible, productive satisfaction versus prestige, esteem	−1 to 1[d]
Physical demands		
STRENGTH	lifting, carrying, pulling, pushing	1 to 5
CLIMB	climbing, balancing	0/1

Continued overleaf

TABLE 7-8 (continued)

Variable Label	Description[a]	Scoring
STOOP	stooping, kneeling, crouching, crawling	0/1
REACH	reaching, handling, fingering, feeling	0/1
TALK	talking, hearing	0/1
SEE	seeing	0/1
Working conditions		
LOCATION	outside working conditions	1 to 3
COLD	extreme cold	0/1
HEAT	extreme heat	0/1
WET	wet, humid	0/1
NOISE	noise, vibration	0/1
HAZARDS	hazardous conditions	0/1
ATMOSPHR	fumes, odors, dust gases, poor ventilation	0/1

[a] Descriptions are taken from the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972).

[b] High scores correspond to low values.

[c] Level 5 is not assigned on this aptitude because it is assumed that every job requires at least a '4.' (Source: *Handbook for Analyzing Jobs* (1972:294).)

[d] Interest variables are sets of bipolar contrasts: 0 corresponds to presence of neither interest in pair; −1 corresponds to presence of second interest in pair; 1 corresponds to presence of first interest in pair.

1968a:374) and worker autonomy, i.e., the extent to which workers are engaged in "prescribed versus discretionary duties" (Fine, 1968b:7). Complexity, skill, and autonomy are probably interrelated attributes of jobs, but presumably they are not identical.

The precise meaning of the "training times" variables is equally unclear. The validity of these variables—general educational development (GED) and specific vocational preparation (SVP)—has been called into question by the extremely high correlations (of the order of .7–.9) between them and measures of the social status or prestige of occupations. Several researchers have suggested that correlations of this magnitude raise doubts about whether these factors accurately measure the functional requirements of jobs or whether they simply measure an occupation's social standing (Duncan et al., 1972; Siegel, 1971). Alternatively, it could be argued that since status or prestige are based on functional requirements (Treiman, 1977: chap. 1), high correlations are an indication of the validity of these variables. That such alternative interpretations are possible is an indication of the lack of precision in the definition of these variables.

The "aptitudes," "interests," and "temperaments" traits reflect a theory of vocational preference for which the empirical support is weak. The idea that the adequate performance of particular jobs requires workers with certain traits may seem reasonable enough, but the constancy of such traits as attributes of individual personality has not been adequately established in general and, in particular, with respect to the traits included in the DOT. (For a more extended discussion of this point, see chapter 8.)

Finally, the working condition and physical demand variables obviously were designed with unskilled factory and physical laboring jobs mainly in mind. As a consequence, they appear not to capture adequately the full range of variability in the working conditions and physical demands of jobs, omitting, for example, distinctions between machine-paced and worker-paced jobs, routine versus nonroutine jobs, etc. One wonders whether the same indicators would be used in devising new scales to measure the working conditions and physical demands of the range of jobs performed today.

These factors and the scales used to rate them were developed in the 1950s on a sample of occupations that were found predominantly in manufacturing industries. The indicators represent a combination of measures taken from several sources, and the details of their development for use in the DOT are not well documented. The worker functions, for example, are an extension and refinement of a classification scheme developed in Great Britain after World War II to facilitate demobilization (International Labour Office, 1952). The aptitude items were chosen to correspond to those available from the General Aptitude Test Battery used by the U.S. Employment Service to screen and profile applicants (Dvorak, 1947). The interest items were adapted from work by Cottle (1950) in an extension of earlier work by Strong (1943) and others. The GED was designed in house by the staff of the Division of Occupational Analysis in recognition of the need to measure training requirements independently of educational credentials or certification. Although the GED scale was validated in the 1960s against school curriculum content, no attempt was made to validate it against any external criterion related to occupational performance. Changes in the occupational structure and related institutions since the development of these scales, e.g., a shift from a predominantly manufacturing to a service economy and changes in school curricula, may have undermined the capacity of these scales to measure the content and requirements of jobs accurately, especially jobs that have recently emerged or changed.

Moreover, substantial advances in psychometric scaling techniques (Nunnally, 1967) and also in the theory of vocational preference (see chapter 8) are not reflected in the DOT worker traits and worker functions. Rather, they are frozen in a now outmoded mold. Scales that more or less adequately reflected the state of the art of vocational trait measurement at midcentury are now outdated. This condition serves to underscore the urgency of adopting a new strategy in producing the DOT that includes as an intrinsic aspect continuous research and technical improvement of the document as a whole and of each of its components.

RELIABILITY

These same considerations undercut the reliability of the worker trait and worker function ratings. As noted in chapter 6, these variables were scored for each occupation on the basis of the subjective ratings made by one or several job analysts. Analysts themselves reported difficulty in assigning scores on certain factors, especially SVP and aptitudes. The reasons cited for this were the ambiguity of the factors and the inadequacy of the instructions contained in the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972). Furthermore, production of the fourth edition DOT was highly decentralized. Analysts were spread across 10 field centers and 1 special project, and there was reportedly little communication or coordination of effort among them, nor were their activities closely supervised by the national office.

In developing new scales or adapting existing scales for use in the third edition DOT, the occupational analysis staff made various checks of the reliability of analysts' ratings of these traits; to a lesser extent, checks of the validity of the ratings were made as well. Most of these studies were conducted using small samples of jobs and raters, and the results were not published, even for internal distribution within the Division of Occupational Analysis.

Prior to publication of the third edition, however, a major study of ratings of 4,000 of the most frequently occurring jobs was conducted. For the study, eight highly trained analysts at the national office of the occupational analysis program rated occupations on a variety of characteristics, using DOT definitions and job descriptions written by analysts in the field on the basis of on-site observations. These ratings, based on descriptions only, were compared with ratings made by eight analysts who observed and rated similar jobs on site.

Results for ratings of aptitudes show that the median correlation between the average ratings of the two groups across all 10 aptitudes was .90. In addition, interrater reliabilities ranging from .74 to .96 were obtained for the national office analysts (Trattner et al., 1955). Although the validity of the ratings was found to be rather low when they were compared with test scores for the GATB, this result was ignored by those designing the collection of worker trait data for the third edition DOT. Attention was focused on the reliability exercise, which was more encouraging. The high degree of correspondence between the ratings made on the basis of job descriptions and those based on direct observations was taken as evidence that ratings could be assigned using job descriptions only. Thus for the third edition DOT, ratings were assigned primarily by national headquarters personnel using job descriptions only, with some assistance from the field center staff.

The fourth edition saw a change in the procedures used to rate jobs and occupations for the DOT. As noted in chapter 6, field center analysts not only collected job data and wrote descriptions but also rated each job with respect to the worker trait and worker function characteristics. In addition, field analysts were responsible for assigning ratings to the occupational composites contained in the DOT, formerly a task of the national office.

Despite changes in the rating procedure, no checks appear to have been made of the validity and reliability of the ratings during the course of fourth edition production. Their validity is a complex issue not easily addressed by us with the means at hand, beyond what we have said above. We were able, however, to assess the reliability of the ratings. A complete description of this exercise appears in Appendix E; here we briefly summarize the exercise and the main results.

We asked experienced analysts at 7 field centers to rate 24 job descriptions with respect to DATA, PEOPLE, THINGS, 3 components of GED, SVP, 6 physical demand factors, and 7 environmental conditions. Job descriptions were taken verbatim from job analysis schedules prepared for the fourth edition. Thus the rating task closely replicated the procedures used to assign scores for the third edition but was an imperfect simulation of the procedures by which ratings for the fourth edition were actually generated. An exact replication of the fourth edition procedure (comparing ratings made on site) was beyond the scope of our project.

Our design enabled us to separate the effect of six potential influences on ratings: the occupation being rated, the GED level of the occupation (four groups), the job type (whether manufacturing or service), the job description used to represent the occupation (each occupation was represented by two descriptions), the field center of the rater (one of seven), and the individual analyst within the field center (one of six). Reliabilities were calculated under three assumptions. The "minimum" estimate treats variance associated with the occupation rated, the GED level, and the job type as legitimate and the variance associated with the

TABLE 7-9 Reliability Estimates for Selected DOT Variables

Variable	Minimum[a] (1)	Medium[b] (2)	Maximum[c] (3)	Job Description Effect (2) − (1)	Rater Effects (3) − (2)
DATA	.84	.85	.90	.01	.05
PEOPLE	.80	.87	.91	.07	.04
THINGS	.25	.46	.65	.21	.19
GED-REASON	.75	.82	.88	.07	.06
GED-MATH	.58	.61	.85	.03	.24
GED-LANGUAGE	.67	.71	.90	.04	.19
SVP	.76	.80	.92	.04	.12
STRENGTH	.34	.54	.73	.20	.19
LOCATION	.64	.66	.76	.02	.10
Average	.63	.70	.83	.07	.13

[a] Reliability assuming that job type (manufacturing versus service), GED level, and occupation (within GED level by job type) are the only legitimate sources of variation in ratings.

[b] Reliability assuming that in addition to the above, the description rated (one of two per occupation) is a legitimate source of variation in ratings.

[c] Reliability assuming that in addition to the above, variance due to differences among field centers and among analysts within field centers are legitimate sources of variation in ratings.

SOURCE: See Appendix E.

remaining factors as error. The "medium" estimate treats the job description rated as an additional legitimate source of variation in ratings. The "maximum" estimate treats differences between raters and field centers as additional legitimate sources of variation. The usefulness of this approach is that the difference between the estimates can be interpreted substantively: the difference between the medium and minimum estimates is the error introduced by the fact that one job description rather than another is rated; and the difference between the maximum and medium estimates is the error introduced by the fact that raters differ from one another in the way they assign ratings.

Table 7-9 shows the three reliability estimates and the differences between estimates for each of nine variables. First, it can be noted that the estimated reliabilities are not very high. The average minimum estimate is only .63, and the average medium estimate is .70 (it is not sensible to interpret the maximum estimates directly; they are used only to derive rater effects). Second, some variables are much more reliably rated than others. In particular, the THINGS and STRENGTH variables are very unreliably estimated. In large part this is due to the fact that ratings of these factors vary substantially depending on which description is rated, whereas the description has less influence on the ratings of the other factors. It is not clear, however, whether jobs vary more widely in their complexity with respect to things and in their strength requirements than in their other characteristics or whether the descriptions are simply less adequate with respect to these two characteristics than with respect to the other characteristics. These results do suggest, however, the importance of adequately sampling jobs within each occupation. Although the "job description" effect is largest for the THINGS and STRENGTH factors, it is also not trivial for a number of other factors, which means that the ratings of occupations (and presumably occupational descriptions as well) are likely to vary substantially, depending on which particular job is chosen to represent the occupation. One way to overcome this is to average the ratings (and descriptions) of several jobs to form a composite occupational description and set of worker function and worker trait scores. Of course, the optimal solution would be to redesign the classification structure to reduce heterogeneity among the jobs included in each occupational category.

Inspecting the last column of Table 7-9, we see that rater effects are even larger on the average than job description effects. Fortunately, we know from the extended analysis in Appendix E that rater effects are almost entirely attributable to differences among individual raters rather than to systematic differences among field centers. This suggests a simple remedy. Each job description should be independently rated for worker traits and worker functions by several analysts. (Appendix E gives estimates of the number of raters needed to achieve specified levels of reliability.)

In a second analysis we calculated reliabilities separately for manufacturing and service occupations. Considering the historical concentration of the DOT on manufacturing jobs, in particular, the emphasis on features of manufacturing jobs in the development of the worker trait variables, we suspected that these variables might be more reliably measured for manufacturing than for service jobs. As Table 7-10 shows, this proved to be the case, with the single exception of the STRENGTH scale. The result for the STRENGTH scale is quite anomalous and suggests that this variable needs to be redesigned or abandoned. More generally, the lower reliablity in the rating of characteristics of service jobs lends credence to the conjecture that the worker function and worker trait scales will become increasingly ill suited to measuring the job content of the American economy as the labor force shifts away from manufacturing jobs, since it is likely that the characteristics of clerical, sales, managerial, and profession-

TABLE 7-10 Estimated Reliabilities, by Type of Occupation[a]

Characteristic[b]	Service	Manufacturing
DATA		
r(minimum)	.694	.880
r(medium)	.727	.889
r(maximum)	.798	.918
PEOPLE		
r(minimum)	.666	.908
r(medium)	.795	.933
r(maximum)	.830	.972
THINGS		
r(minimum)	.107	.186
r(medium)	.329	.406
r(maximum)	.632	.637
GED–REASON		
r(minimum)	.652	.694
r(medium)	.717	.794
r(maximum)	.792	.888
GED–MATH		
r(minimum)	.422	.629
r(medium)	.431	.682
r(maximum)	.771	.878
GED–LANGUAGE		
r(minimum)	.552	.690
r(medium)	.609	.739
r(maximum)	.853	.862
SVP		
r(minimum)	.724	.768
r(medium)	.739	.834
r(maximum)	.873	.925
STRENGTH		
r(minimum)	.435	.138
r(medium)	.594	.495
r(maximum)	.724	.705

[a] Reliabilities are calculated under three different assumptions about sources of error. See Table 7-9.

[b] Reliabilities for the LOCATION scale could not be calculated separately for service and manufacturing occupations because there was no variation on this scale for the manufacturing occupations.

al jobs will also be less reliably measured than the characteristics of manufacturing jobs.

In addition to the variables discussed above, five physical demands and six environmental conditions were rated. Since these variables are all dichotomous, a different approach was required, described in Appendix E. It is sufficient to note here that the results closely paralleled those we have already reviewed: consistency among raters was only moderate, was much greater for some variables than for others, and was generally lower for service than for manufacturing occupations.

In sum, this exercise strongly suggests that the reliability and consistency of the rating of worker functions and worker traits should and can be substantially improved and that this could be quite simply accomplished by adopting standard psychometric procedures involving the rating of multiple job descriptions for each occupation independently by several analysts each. In addition, those variables with particularly low reliability should be reviewed with an eye to improving the reliablity of their measurement. Finally, consideration should be given to the development of multiple-item scales to measure occupational characteristics. We shall have more to say about this below in our discussion of a factor analysis of the worker function and worker trait variables.

OCCUPATIONAL CHARACTERISTICS

Despite the problems of validity and reliability identified above, the DOT worker functions and worker traits constitute one of the richest sources of occupational data available anywhere. We have already noted (in chapter 4) the wide variety of uses made of these data. As an aid to researchers contemplating further use of these data, we report in this section the results of a number of analyses that investigate the distributional properties of these variables and the interrelationships among them. Data used in the analyses were supplied by the national office of the Division of Occupational Analysis. A DOT summary tape made available to us provided data on DOT codes, worker functions, and worker traits for the 12,099 base title occupations in the DOT. The following analyses are based on a 10-percent random sample of these titles. The definitions and scoring of the worker functions and traits are described in Table 7-8.

Table 7-11 presents descriptive statistics for each DOT variable. Note that these statistics pertain to the population of occupations included in the DOT and not to individuals in the labor force. Insofar as the labor force is unevenly distributed over occupational categories, the occupational characteristics of workers would be expected to differ from the characteristics of occupations, but we have not systematically investigated the extent

TABLE 7-11 Descriptive Statistics for Fourth Edition DOT Occupational Characteristics[a]

Variable Label[b]	Mean	SD	Kurtosis	Skew	Range
Worker functions					
DATA	4.11	2.09	−1.40	−0.47	6
PEOPLE	6.83	1.85	1.90	−1.63	8
THINGS	4.32	2.31	−1.27	−0.28	7
Training times					
GED	3.00	1.09	−0.45	0.12	5
SVP	4.46	2.06	−1.26	0.23	8
Aptitudes					
INTELL	3.19	0.72	0.31	−0.65	3
VERBAL	3.43	0.78	0.83	−1.17	4
NUMER	3.63	0.78	0.43	−0.49	4
SPATIAL	3.47	0.71	0.37	−0.77	4
FORM	3.36	0.67	−0.30	−0.53	4
CLERICAL	3.89	0.79	−0.28	−0.36	3
MOTOR	3.46	0.56	−0.79	−0.24	3
FINGDEX	3.56	0.61	0.30	−0.88	4
MANDEX	3.21	0.53	0.72	0.32	4
EYEHAND	4.67	0.60	2.89	−1.80	4
COLORDIS	4.52	0.70	1.85	−1.42	4
Temperaments[c]					
DCP	0.18	0.38	—	—	1
FIF	0.01	0.10	—	—	1
INFLU	0.04	0.20	—	—	1
SJC	0.17	0.38	—	—	1
MVC	0.39	0.49	—	—	1
DEPL	0.23	0.42	—	—	1
REPCON	0.46	0.50	—	—	1
PUS	0.02	0.16	—	—	1
STS	0.60	0.49	—	—	1
VARCH	0.20	0.40	—	—	1
Interests					
DATACOM	−0.57	0.66	0.27	1.23	2
SCIENCE	−0.12	0.45	1.40	−0.49	2
ABSTRACT	−0.47	0.53	−1.25	0.21	2
MACHINE	0.62	0.55	0.08	−1.05	2
TANGIBLE	−0.05	0.47	1.50	−0.18	2
Physical demands[c]					
STRENGTH	2.39	0.91	−0.15	0.42	4
CLIMB	0.08	0.27	—	—	1
STOOP	0.20	0.40	—	—	1
REACH	0.89	0.31	—	—	1
TALK	0.29	0.45	—	—	1
SEE	0.57	0.49	—	—	1

TABLE 7-11 (continued)

Variable Label[b]	Mean	SD	Kurtosis	Skew	Range
Working conditions[c]					
LOCATION	1.22	0.56	4.41	2.40	2
COLD	0.01	0.08	–	–	1
HEAT	0.05	0.21	–	–	1
WET	0.07	0.25	–	–	1
NOISE	0.29	0.45	–	–	1
HAZARDS	0.15	0.35	–	–	1
ATMOSPHR	0.12	0.33	–	–	1

[a] Based on 10-percent random sample of DOT occupations, $N = 1{,}172$.

[b] For variable descriptions and scoring, see Table 7-8.

[c] Kurtosis and skew coefficients are not presented for dichotomous variables.

of the difference. The average occupation in the DOT involves relatively low levels of complexity: computing data, serving people, and manipulating things. The average occupation requires GED at the level of being able to solve practical problems, perform simple algebra, and read newspapers and novels. Six months to a year of SVP is typically needed, as are aptitudes at levels presumed to be possessed by the middle-to-lower third of the population of workers. Adaptability to working with measurable or verifiable criteria, with set limits, tolerances, or standards and with repetitive, continuous processes is a significant requirement of more than a third of the occupations contained in the DOT. Most occupations are also characterized by interest in working with things and machines and in routine activities, and most also involve reaching and seeing. Arduous physical activities or noxious working conditions, however, are present in a relatively small proportion of occupations.

An inspection of the means of the dichotomous variables (temperaments, physical demands, and working conditions except STRENGTH and LOCATION) indicates that some of the DOT characteristics occur with low frequency (the mean of a dichotomy is the proportion positive). The temperaments involving feelings, ideas, or facts, influencing people, and performing under stress are required in fewer than 10 percent of all occupations, for example, as are the physical demands involving climbing and exposure to cold, heat, and wetness. The aptitude variables have particularly small standard deviations, indicating limited variance on these traits as well. In addition, the range of two of the aptitudes, CLERICAL and MOTOR, is small: no occupations are scored as requiring the highest aptitude level. An inspection of the frequency distributions of the aptitude variables (not shown) reveals that even for those for which the range is not restricted, cases are highly concentrated in one or two of the available five levels.

In line with this, data in the third and fourth columns of Table 7-11 indicate that many of the variables exhibit markedly nonnormal distributions. The skewness and kurtosis coefficients presented in these columns are measures of the degree to which a distribution approximates a normal curve. Skewness is a measure of the symmetry of the distribution; kurtosis measures the flatness or peakedness of the curve. Both coefficients equal zero for normal distributions. The distributions of the PEOPLE worker function; the VERBAL, EYEHAND, and COLORDIS aptitudes; the DATACOM and MACHINE interests; and the LOCATION working condition are particularly skewed. On PEOPLE, for example, 63 percent of all occupations are rated at the lowest level, taking instructions-helping, causing the distribution to have a pronounced peak at its extreme tail. The variables DATA, PEOPLE, THINGS, SVP, EYEHAND, ABSTRACT, TANGIBLE, and LOCATION exhibit distributions that are markedly more peaked or flatter than normal, with kurtosis coefficients larger than 1 in absolute value. Among the variables that are not dichotomous, the remaining distributions, notably GED, more closely approximate normality.

The distributional characteristics just presented raise several issues worthy of additional consideration. Assuming that the DOT variables accurately reflect the dimensions of an occupation that they are intended to measure, one might ask whether there is a need for analysts to rate occupations for traits that seldom occur or for traits that always occur, i.e., traits that never vary. In some cases, of course, the traits are important attributes of the jobs they characterize, even if such jobs are rare. Working conditions involving extreme cold, heat, or wetness would be of this type. In other cases, such as for many of the temperaments, however, the traits are of little practical interest to job applicants and are useful mainly for research purposes. In such cases the limited variation of highly skewed variables is a matter of considerable importance since it reduces the discriminatory power of these variables. This suggests the need to look into the scaling properties of these measures, which are largely unknown.

THE FACTOR STRUCTURE

Each of the 44 DOT variables is supposed to reflect a distinct occupational characteristic. Several researchers (Spenner, 1977; Temme, 1975) have noted, however, that many of the variables appear to measure nearly identical phenomena, as evidenced both by the content of the items (Table

7-8) and by the high degree of intercorrelation among them (Table 7-12). In order to determine the underlying dimensions tapped by the full set of DOT variables, we factor-analyzed the 44 DOT variables (using the SPSS computer program for principal components with iterations and varimax rotation) for a 10-percent random sample of DOT occupations (N = 1,172). Six interpretable factors emerged. Factor loadings for the analysis are shown in Table 7-13. Generally, .40 was chosen as the cutoff point for including an item in a factor. By this criterion a number of items did not load on any factor. If on closer inspection these items had factor loadings between .30 and .40 on a given factor and if they corresponded in content to other items on the factor, the decision rule was relaxed, and these items were included in the list of items defining the factor. The six orthogonal factors that emerged account for 95 percent of the common variance in the correlation matrix. The item composition of each of the factors plus factor loadings and the percentage of variance explained by each are given in Table 7-14.

The first factor (Table 7-14) accounts for 49 percent of the total shared variance and consists of 17 items with loadings greater than .40. An inspection of the items suggests that this factor reflects the substantive complexity of work, as witnessed by the high loadings of the training variables GED and SVP; the worker functions DATA and PEOPLE; and the aptitudes INTELL, NUMER, and VERBAL. The loadings of the temperament variables REPCON and VARCH also reinforce the interpretation of this factor as reflecting the complexity of tasks and routines entailed in occupations.

The second factor accounts for 23 percent of the shared variance. The high loadings of the variables FINGDEX, MANDEX, REACH, and SEE as well as those of the machine-related THINGS and MACHINE variables clearly indicate that this factor reflects the motor or sensory skills required by occupations.

The third factor, which accounts for 10 percent of the shared variance, also taps a dimension of the physical requirements of jobs, but the high positive loadings of the variables LOCATION, STOOP, CLIMB, and STRENGTH coupled with the negative loading of EYEHAND indicate that this factor reflects the arduous physical requirements of occupations, i.e., those characterized more by brawn than by fine motor skills.

The fourth factor accounts for only 5 percent of the shared variance, but the items that load strongly on it clearly represent the organizational or administrative components of occupations such as dealing with people (DEPL and PEOPLE) and directing or planning (DCP). It should be noted that factors 1 and 4 share a number of items in common (DATA, PEOPLE, DCP, DATACOM, and TALK), a fact that indicates that there is a close

TABLE 7-12 Means, Standard Deviations, and Correlation Coefficients for DOT Variables[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Correlation coefficients															
1. DATA	1.00														
2. PEOPLE	.70	1.00													
3. THINGS	.22	−.00	1.00												
4. GED	−.84	−.62	−.26	1.00											
5. SVP	−.84	−.59	−.41	.88	1.00										
6. INTELL	.75	.51	.20	−.86	−.79	1.00									
7. VERBAL	.81	.62	.07	−.83	−.73	.82	1.00								
8. NUMER	.72	.48	.23	−.77	−.71	.73	.71	1.00							
9. SPATIAL	.44	.23	.48	−.53	−.59	.51	.40	.47	1.00						
10. FORM	.37	.15	.44	−.45	−.50	.40	.32	.41	.60	1.00					
11. CLERICAL	.66	.49	.05	−.65	−.58	.61	.63	.68	.21	.23	1.00				
12. MOTOR	.0[illegible]	−.08	.44	−.10	−.14	.09	.00	.09	.31	.31	.02	1.00			
13. FINGDEX	.16	−.00	.46	−.21	−.23	.19	.14	.20	.36	.47	.12	.53	1.00		
14. MANDEX	−.15	−.21	.47	.10	.01	−.12	−.22	−.08	.27	.25	−.20	.52	.44	1.00	
15. EYEHAND	−.06	−.01	.12	.02	−.01	−.03	−.09	−.05	.12	.00	−.10	.18	.04	.15	1.00
16. COLORDIS	.25	.13	.26	−.26	−.30	.24	.21	.23	.25	.39	.16	.12	.22	.11	.11
17. DATACOM	−.59	−.59	.15	.57	.47	−.51	−.61	−.42	−.13	−.10	−.50	.07	.01	.28	.05
18. SCIENCE	.25	.37	−.19	−.14	−.13	.07	.16	.08	−.14	−.13	.21	−.13	−.18	−.27	−.04
19. ABSTRACT	−.68	−.47	−.28	.66	.68	−.62	−.60	−.52	−.43	−.36	−.44	−.06	−.18	.05	.02
20. MACHINE	.20	.31	−.42	−.17	−.03	.20	.34	.14	−.15	−.15	.20	−.18	−.12	−.28	−.05
21. TANGIBLE	.30	.51	−.29	−.22	−.18	.17	.26	.18	−.08	−.12	.24	−.21	−.24	−.32	−.09
22. DCP	−.69	−.73	.06	.56	.57	−.46	−.56	−.46	−.18	−.13	−.44	.11	.07	.24	.05

23. FIF	−.20	−.11	−.01	.20	.15	−.21	−.23	−.05	−.09	−.04	−.07	−.03	−.08	.02	.06
24. INFLU	−.23	−.30	.16	.28	.18	−.26	−.32	−.20	−.03	−.03	−.21	.08	.03	.16	.05
25. SJC	−.35	−.27	.05	.37	.31	−.39	−.39	−.28	−.17	−.18	−.23	.03	−.06	.14	−.05
26. MVC	−.45	−.19	−.41	.45	.54	−.39	−.32	−.42	−.45	−.39	−.30	−.16	−.19	−.10	−.01
27. DEPL	−.65	−.77	.16	.57	.51	−.48	−.60	−.45	−.11	−.07	−.50	.12	.08	.33	.04
28. REPCON	.73	.49	.28	−.70	−.73	.65	.61	.58	.42	.37	.53	.05	.15	−.08	−.01
29. PUS	−.03	−.05	−.01	.05	.05	−.07	−.07	.01	−.04	−.03	−.04	−.06	.01	.02	−.17
30. STS	.11	.28	−.45	.02	.08	−.03	.17	−.05	−.20	−.26	.03	−.26	−.26	−.30	.01
31. VARCH	−.54	−.45	−.16	.44	.49	−.35	−.41	−.39	−.26	−.19	−.35	−.03	−.06	.01	−.04
32. STRENGTH	.33	.25	−.13	−.35	−.25	.34	.41	.31	.02	.14	.41	−.03	.17	−.24	−.21
33. CLIMB	.00	−.01	−.07	.01	.06	−.02	.04	.00	−.10	.01	.05	−.00	.02	−.02	−.24
34. STOOP	.07	.08	−.12	−.08	−.02	.07	.13	.08	−.07	.02	.16	−.07	.01	−.11	−.24
35. REACH	.41	.42	−.33	−.40	−.31	.38	.47	.34	−.03	−.06	.37	−.25	−.20	−.44	−.11
36. TALK	−.66	−.72	.09	.59	.53	−.50	−.62	−.45	−.16	−.12	−.50	.08	.04	.30	.00
37. SEE	−.16	−.02	−.33	.20	.25	−.19	−.09	−.19	−.33	−.39	−.11	−.27	−.35	−.21	−.13
38. LOCATION	−.06	−.07	−.02	.05	.08	−.06	−.01	.01	−.14	.02	.06	−.02	.07	−.04	−.38
39. COLD	−.02	−.00	.02	.04	.03	−.04	−.01	−.03	−.04	−.02	−.03	.02	.02	−.01	.04
40. HEAT	.05	.05	−.05	−.05	−.03	.04	.07	.02	.04	.01	.05	.05	.09	.01	.02
41. WET	.08	.04	.00	−.08	−.04	.07	.08	.10	.07	.07	.10	.06	.10	.01	−.06
42. NOISE	.13	.07	−.16	−.13	−.06	.16	.20	.11	−.06	.02	.16	−.08	.03	−.13	−.16
43. HAZARDS	.08	.06	−.11	−.05	.00	.04	.12	.07	−.08	.01	.14	−.07	.08	−.10	−.19
44. ATMOSPHR	.06	.02	−.06	−.08	−.02	.06	.11	.03	−.00	.03	.09	−.05	.08	.09	−.05
Means	4.1	6.8	4.3	3.0	4.5	3.2	3.4	3.6	3.5	3.4	3.9	3.5	3.6	3.2	4.7
Standard deviations	2.1	1.8	2.3	1.1	2.1	.72	.78	.78	.71	.67	.79	.56	.61	.53	.60

[a] See Table 7-8 for scoring of DOT variables.

TABLE 7-12 (Continued)

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Correlation coefficients															
1. DATA															
2. PEOPLE															
3. THINGS															
4. GED															
5. SVP															
6. INTELL															
7. VERBAL															
8. NUMER															
9. SPATIAL															
10. FORM															
11. CLERICAL															
12. MOTOR															
13. FINGDEX															
14. MANDEX															
15. EYEHAND															
16. COLORDIS	1.00														
17. DATACOM	−.10	1.00													
18. SCIENCE	−.09	−.42	1.00												
19. ABSTRACT	−.24	.47	−.14	1.00											
20. MACHINE	−.03	−.43	.18	−.10	1.00										
21. TANGIBLE	−.09	−.33	39	−.10	.19	1.00									

22. DCP	−.09	.51	−.38	.43	−.21	−.60	1.00								
23. FIF	−.09	.20	−.01	.26	−.07	.06	.10	1.00							
24. INFLU	−.08	.37	−.28	.20	−.28	−.09	.16	.10	1.00						
25. SJC	−.22	.35	−.12	.36	−.20	−.03	.18	.21	.31	1.00					
26. MVC	−.21	.10	.08	.44	.18	.05	.13	−.08	−.06	.04	1.00				
27. DEPL	−.07	.68	−.57	.43	−.37	−.55	.70	.10	.31	.28	.10	1.00			
28. REPCON	.27	−.45	.19	−.70	.08	.12	−.43	−.10	−.19	−.37	−.63	−.47	1.00		
29. PUS	−.05	.13	−.06	.08	−.04	−.01	−.03	.04	−.00	.09	.03	.08	−.09	1.00	
30. STS	−.08	−.30	.25	−.02	.44	.27	−.29	−.08	−.22	−.19	.23	−.38	−.04	−.08	1.00
31. VARCH	−.14	.33	−.20	.39	−.08	−.20	.47	−.03	−.00	.11	.23	.43	−.46	.00	−.17
32. STRENGTH	.05	−.36	.14	−.17	.20	.23	−.28	−.09	−.13	−.10	−.04	−.31	.20	.03	.06
33. CLIMB	−.01	−.10	.04	.03	.10	.08	−.04	−.03	−.06	.04	.05	−.05	−.07	.03	.07
34. STOOP	−.03	−.17	.09	.02	.07	.19	−.13	−.03	−.08	.02	.04	−.15	.00	.05	.05
35. REACH	−.06	−.52	.38	−.29	.38	.35	−.42	−.10	−.31	−.27	−.02	−.50	.30	.00	.28
36. TALK	−.13	.64	−.49	.45	−.32	−.42	.63	.13	.29	.31	.14	.77	−.49	.12	−.30
37. SEE	−.32	−.06	.16	.17	.18	.13	.01	.03	−.04	.05	.30	−.06	−.20	.08	.26
38. LOCATION	−.00	−.04	.02	.07	.02	−.00	.07	−.03	−.02	.10	.06	.02	−.08	.08	−.07
39. COLD	−.01	−.00	−.03	−.01	−.01	−.04	.02	−.01	−.02	.05	.01	.04	−.03	−.01	.02
40. HEAT	−.10	−.08	.02	−.04	.10	.02	−.05	−.02	−.04	−.01	.02	−.06	−.01	−.01	.05
41. WET	.03	−.10	.01	−.05	.09	.04	−.02	−.03	−.04	.03	−.05	−.06	.06	.02	−.01
42. NOISE	.05	−.16	.04	−.07	.24	.04	−.05	−.05	−.10	−.10	.04	−.13	.07	.05	.07
43. HAZARDS	−.01	−.12	.03	−.07	.14	.07	−.10	−.04	−.08	+.02	.07	−.11	.01	.22	.08
44. ATMOSPHR	−.01	−.09	.01	−.05	.10	.01	−.03	−.01	−.05	−.03	.04	−.06	.02	.04	.05
Means	4.50	−.57	−.12	−.47	.62	−.05	.18	.01	.04	.17	.39	.23	.46	.02	.60
Standard deviations	.70	.66	.45	.53	.55	.47	.38	.10	.20	.38	.49	.42	.50	.16	.49

TABLE 7-12 (continued)

	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Correlation coefficient														
1. DATA														
2. PEOPLE														
3. THINGS														
4. GED														
5. SVP														
6. INTELL														
7. VERBAL														
8. NUMER														
9. SPATIAL														
10. FORM														
11. CLERICAL														
12. MOTOR														
13. FINGDEX														
14. MANDEX														
15. EYEHAND														
16. COLORDIS														
17. DATACOM														
18. SCIENCE														
19. ABSTRACT														
20. MACHINE														
21. TANGIBLE														

22. DCP														
23. FIF														
24. INFLU														
25. SJC														
26. MVC														
27. DEPL														
28. REPCON														
29. PUS														
30. STS														
31. VARCH	1.00													
32. STRENGTH	−.11	1.00												
33. CLIMB	.05	.21	1.00											
34. STOOP	.02	.44	.37	1.00										
35. REACH	−.20	.33	.06	.16	1.00									
36. TALK	.42	−.31	.00	−.09	−.48	1.00								
37. SEE	.08	−.03	.02	.03	.18	.00	1.00							
38. LOCATION	.08	.26	.38	.30	.02	.04	.02	1.00						
39. COLD	−.01	.04	.14	.02	−.01	.02	.02	.01	1.00					
40. HEAT	−.02	.11	.13	.05	.06	−.08	.00	−.04	.09	1.00				
41. WET	−.01	.19	.15	.17	.07	−.07	−.04	.13	.07	.13	1.00			
42. NOISE	.00	.26	.13	.21	.17	−.09	.10	.08	−.03	.07	.06	1.00		
43. HAZARDS	−.02	.31	.30	.22	.10	−.08	.10	.18	.03	.16	.16	.22	1.00	
44. ATMOSPHR	−.02	.22	.18	.18	.10	−.08	.04	.08	.04	.16	.04	.19	.32	1.00
Means	.20	2.4	.08	.20	.89	.29	.57	1.2	.01	.05	.07	.29	.15	.12
Standard deviations	.40	.91	.27	.40	.31	.45	.49	.56	.08	.21	.25	.45	.35	.33

TABLE 7-13 Factor Loadings: Varimax Rotated Factor Matrix[a]

	Factor					
Variable[b]	1	2	3	4	5	6
DATA	**.81**	.06	−.02	**.44**	.17	−.05
PEOPLE	**.47**	−.05	.02	**.70**	.17	−.01
THINGS	.31	**.66**	.06	−.15	−.16	.13
GED	**.86**	.12	−.04	.26	.21	−.01
SVP	**.86**	.22	.02	.27	.09	.05
INTELL	**.83**	.07	−.03	.14	.26	−.00
VERBAL	**.76**	−.04	−.08	.29	.33	−.11
NUMER	**.78**	.09	−.09	.18	.05	−.01
SPATIAL	**.55**	**.47**	.16	−.03	.05	.03
FORM	**.46**	**.52**	−.07	−.07	.07	.01
CLERICAL	**.64**	−.04	−.19	.27	.03	−.11
MOTOR	.02	**.68**	.07	−.04	−.03	−.08
FINGDEX	.16	**.69**	−.08	−.10	.08	−.21
MANDEX	−.13	**.67**	.13	−.16	−.07	−.00
EYEHAND	−.05	.17	**.52**	.03	−.04	−.03
COLORDIS	.28	.28	−.00	−.04	.17	.06
DATACOM	**.41**	−.14	−.12	**.49**	.37	−.15
SCIENCE	−.02	.21	.10	**−.57**	−.08	−.01
ABSTRACT	**.68**	.11	.04	.19	.28	−.06
MACHINE	−.05	.33	.01	−.24	−.37	.26
TANGIBLE	−.10	.27	.12	**−.63**	.13	−.04
DCP	**.43**	−.09	−.02	**.74**	.04	.00
FIF	.10	.06	−.05	.01	**.41**	.01
INFLU	.15	−.12	−.08	.17	**.41**	−.05
SJC	.31	−.05	.09	.07	**.51**	−.00
MVC	**.64**	.19	.03	−.10	−.27	.03
DEPL	.39	−.16	−.06	**.78**	.18	−.08
REPCON	**−.81**	−.04	−.03	−.17	−.08	.03
PUS	.03	.05	.13	.06	.07	.07
STS	.13	.37	−.12	−.39	−.31	.16
VARCH	**.42**	.06	.13	**.40**	−.05	−.06
STRENGTH	−.30	.06	**.48**	−.16	−.04	.30
CLIMB	.08	−.02	**.49**	−.06	−.04	.28
STOOP	−.03	.05	**.53**	−.11	.03	.20
REACH	−.34	**.42**	.12	−.33	−.21	.11
TALK	**.44**	−.11	−.01	**.64**	.21	−.08
SEE	.24	**.43**	.01	−.10	−.06	.08
LOCATION	.08	−.03	**.67**	.03	−.05	−.00
COLD	.04	−.02	.01	.00	.02	.15
HEAT	−.01	−.03	−.03	−.05	−.01	.37
WET	−.06	−.07	.18	−.03	.02	.22
NOISE	−.12	.14	.19	.03	−.15	.26
HAZARDS	−.03	.08	.29	−.04	−.07	**.52**
ATMOSPHR	−.05	.05	.14	.02	−.05	**.42**

TABLE 7-13 (continued)

	Factor					
Variable[b]	1	2	3	4	5	6
Eigenvalue	10.86	4.98	2.18	1.20	1.09	0.63
Percentage variance	49.30	22.60	9.90	5.40	4.90	2.90
Cumulative percentage	49.30	72.00	81.90	87.30	92.20	95.10

[a] Factor loadings greater than or equal to .4 are in boldface.

[b] Where necessary, scores on variables were reflected so that high scores represent high levels of the trait.

relationship in the DOT between the substantive complexity of occupations and their managerial responsibilities.

The fifth and sixth factors account for 5 and 3 percent of the shared variance in the matrix, respectively. Factor 5, which is composed of only 4 items, might be labeled "interpersonal skills." An inspection of the items' content reveals that this dimension involves working with feelings and ideas and sensory or judgmental criteria and that it involves influencing people and dealing with their social welfare. The sixth factor, although it accounts for only 3 percent of the variance, is readily interpretable as reflecting undesirable aspects of the working conditions of occupations.

By and large, the results of this factor analysis are straightforward. Several variables did load on more than one factor: as noted, there is some overlap between factors 1 and 4; factors 1 and 2 also share two items in common. Only five variables (COLORDIS, PUS, COLD, WET, and NOISE), failed to load significantly on any of the factors. Of these five variables, all but COLORDIS are dichotomous variables with limited variance. The variable COLORDIS (occupations requiring an aptitude for color discrimination) appears to tap a unique occupational dimension. Presumably, many occupations require similar special aptitudes, but since each aptitude is probably required of only a few occupations, it would be preferable to include such information as part of the occupational definition.

These results can be interpreted in two ways. The most straightforward interpretation is simply that there is a great deal of redundancy among DOT indicators. Alternatively, the factor patterns just presented could result from the procedures used in making DOT ratings. In rating occupations for these traits, occupational analysts might have forced consistency among them. It is true that many of the functions and traits appear to tap nearly identical phenomena (e.g., GED and INTELL). However, it is also the case that the way in which the ratings were made—

TABLE 7-14 Factor Analysis of Fourth Edition DOT Occupational Characteristics: Items and Loadings for Six Major Factors

Variable Label	Description	Loading
Factor 1: substantive complexity, 49.3 percent[a]		
GED	general educational development	.86
SVP	specific vocational preparation	.86
INTELL	intelligence[b]	.83
DATA	complexity of functioning with data[b]	.81
REPCON	repetitive or continuous processes	.81
NUMER	numerical aptitude[b]	.78
VERBAL	verbal aptitude[b]	.76
ABSTRACT	abstract and creative versus routine, concrete activities	.68
MVC	measurable or verifiable criteria	.64
CLERICAL	clerical perception[b]	.64
SPATIAL	spatial perception[b]	.55
PEOPLE	complexity of functioning with people[b]	.47
FORM	form perception[b]	.45
TALK	talking	.44
DCP	direction, control, and planning	.43
VARCH	variety and change	.42
DATACOM	communication of data versus activities with things	.41
Factor 2: motor skills, 22.6 percent[a]		
FINGDEX	finger dexterity[b]	.69
MOTOR	motor coordination[b]	.68
MANDEX	manual dexterity[b]	.67
THINGS	complexity of functioning with things[b]	.66
FORM	form perception[b]	.52
SPATIAL	spatial perception[b]	.47
SEE	seeing	.43
REACH	reaching	.42
STS	set limits, tolerances, or standards	.37
MACHINE	activities involving processes, machines versus social welfare	.33
Factor 3: physical demands, 9.9 percent[a]		
LOCATION	outside working conditions	.67
STOOP	stooping, kneeling, crouching, crawling	.53
EYEHAND	eye-hand-foot coordination[b]	.52
CLIMB	climbing, balancing	.49
STRENGTH	lifting, carrying, pulling, pushing	.48
Factor 4: management, 5.4 percent[a]		
DEPL	dealing with people	.78
DCP	direction, control, planning	.74
PEOPLE	complexity of functioning with people[b]	.70
TALK	talking	.64

TABLE 7-14 (continued)

Variable Label	Description	Loading
TANGIBLE	activities resulting in tangible satisfaction versus prestige	−.63
SCIENCE	scientific, technical activities versus business contact	−.57
DATACOM	communication of data versus activities with things	.49
DATA	complexity of functioning with data[b]	.44
Factor 5: interpersonal skills, 4.9 percent[a]		
SJC	sensory or judgmental criteria	.51
FIF	feelings, ideas, facts	.41
INFLU	influencing people	.41
MACHINE	activities involving processes, machines versus social welfare	−.37
Factor 6: undesirable working conditions, 2.9 percent[a]		
HAZARDS	hazardous conditions	.52
ATMOSPHR	fumes, odors, dust, poor ventilation	.42
HEAT	extreme heat	.37

[a] Percentage of common variance explained.
[b] Sign reflected on this variable.

all ratings assigned at one time by a single analyst—could have inflated the degree of consistency among the scores for each occupation and hence the degree of correlation between variables measured over occupations. This is called a "halo effect," the tendency of one judgment to be affected by another. It is well known that when several ratings are made at a single time by a single judge, they tend to be more consistent than when the ratings are made independently of one another (Selltiz et al., 1959:351–352).

Evidence that the rating procedure itself is an important source of the high degree of interrelationship among the DOT variables is offered by the results of a similar factor analysis performed by using third edition data (Barker, 1969). For the third edition, different analysts rated each of the traits: one analyst rated occupations for aptitudes, another for temperaments, etc., a procedure that would mitigate the tendency to force consistency among the ratings. In an analysis of third edition ratings, Barker found that 11 factors emerged and that the factor loadings, commonalities, and percentage of common variance explained were all much lower than the estimates presented here. Although other reasons could account for the differences between his findings and ours (e.g., differences in the underlying distribution of occupations), the suspicion is strong that the differences are attributable to the change in the rating procedures from the third to fourth edition, that is, that the high covariation among the worker functions and worker traits is an artifact at least in part of the procedures used to rate DOT occupations. If this is so, these findings suggest that a modification of current rating procedures is needed along with a careful examination of the content of the items themselves.

These results suggest that the more reliable indicators of the features of occupations tapped by the worker traits and worker functions variables could be created by developing factor-based multiple-item scales to represent the various dimensions revealed by the factor analysis. Such scales would have the advantage of greater internal reliabiilty and consistency than single indicators or scales created by simple summing of items without knowledge of their factor structure. In Appendix F we present scores for scales constructed in this way for the categories of the 1970 U.S. Census detailed occupational classification.

SEX BIAS IN THE RATING OF OCCUPATIONS

Recently, the DOT has come under attack for alleged sex bias. It has been claimed that in the third edition DOT both the occupational descriptions and the ratings of occupational characteristics undervalued jobs held mainly by women (Witt and Naherny, 1975). In particular, it has been asserted that third edition ratings of the complexity of work in relation to data, people, and things reflect traditional stereotypes regarding the relative complexity of the kinds of jobs typically held by women and those typically held by men (Witt and Naherny, 1975). Consideration of a few examples is sufficient to legitimate the charge of sex bias in the third edition. In it the DATA, PEOPLE, and THINGS variables included as the lowest response level a judgment that an occupation had "no significant relationship" to data, people, or things. Typist, a job held mainly by women, was coded as having no significant relationship to things, whereas Typesetting-Machine Tender, a job held mainly by men, was coded at a higher level of complexity. Such jobs as Nursery School Teacher and Practical Nurse were coded as having minimal or no significant relationship to data, people, and things, while such jobs as Dog Pound Attendant were rated as functioning at a higher level of complexity.

According to informants in the national office the no significant relationship category for the worker functions was dropped in the fourth edition in response to the charge of sex bias in the third edition. Occupations that had been scored at the lowest complexity levels in the third edition were assigned new worker function scores. In addition, in some instances other scores were changed, presumably to reflect changes in job content or to correct other errors in the third edition.

In order to document the changes made between the third and fourth editions and to determine whether the ratings of occupations commonly pursued by women had been upgraded as claimed, we conducted an analysis of third and fourth edition worker function ratings. This was done by utilizing the April 1971 *Current Population Survey* (CPS) of a representative sample of the labor force. This data set contains, among other variables, both the third and fourth edition DOT codes for the job held at the time of the survey and the sex of each worker. The CPS data set includes data for 60,441 members of the labor force. Third edition DOT codes were assigned to each occupational response by trained occupational analysts in the occupational analysis field centers. Fourth edition codes were subsequently added to the data, using a map prepared by the Division of Occupational Analysis that related fourth edition DOT codes to third edition codes. By comparing third and fourth edition scores on the DATA, PEOPLE, and THINGS variables separately for men and women, we can determine the effect of scoring changes between the third and fourth editions on the relative status of male and female workers. Note that our sample for this analysis is composed of workers, not jobs. However, neither workers nor jobs changed, only the classification of jobs in the DOT scheme and hence the scoring of the worker function variables. An analysis of the nature of these changes permits an indirect inference about the extent of sex bias remaining in the fourth edition DOT.

We begin by considering the labor force as a whole (see Table 7-15). In 1971, about a third of both the male and female labor force were in occupations that were judged in the third edition to have no significant relationship to data. In contrast, a much larger proportion of men than women were in occupations having no significant relationship to people, and a much larger proportion of women than men were in occupations with no significant relationship to things. The second line of the table, which gives the mean fourth edition score for occupations with "no significant relationship" in the third edition, shows what happened to these occupations in the fourth edition. On average, the occupations held by men and those held by women were assigned similar scores on the DATA and PEOPLE variables, but on the THINGS variable the occupations held by women were judged to be more complex than the occupations held by men. In short, the major effect of the abolition of the no significant relationship category was to upgrade substantially the complexity in relation to things of occupations held by women. This conclusion is also evident in the "difference in means" row, which shows the difference in the average score between the third and fourth editions. Since a low score means greater complexity, the fact that all the numbers in the row are negative indicates an average upgrading of complexity levels between the third and fourth editions. The only change of substantive importance, however, is the upgrading of occupations held by women on the THINGS variable.

The remaining point to note concerning the total labor force is that except for changes required by the abolition of the no significant relationship codes, there were few changes in ratings between the third and fourth editions. More than 90 percent of the scores remained unchanged between the two editions, as perhaps was to be expected, given the way in which DOT occupational data were generated.

Inspection of the second section of Table 7-15 allows us to identify a major source of change in the THINGS ratings: the upgrading of clerical and sales jobs held by women. Most clerical and sales jobs (whether held by men or women) were identified in the third edition as having no significant relationship to things. However, the occupations held by women were coded substantially differently on the THINGS variable in the fourth edition from those held by men; on average, the clerical and sales occupations held by women were judged as having much greater complexity than those held by men. No doubt this reflects the greater propensity of female clerical and sales workers than male clerical and sales workers to operate office machines. Whereas in the third edition the task of typing was rated as not involving a significant relationship to things (level 8), in the fourth edition it was rated as involving the "operating-controlling" of things (level 2). The same sort of coding change was made for a large number of positions involving the operation of office machines. Hence while both clerical and sales occupations held by women and those held by men tended to be upgraded in the fourth edition, the upgrading was much greater for the jobs held by women. Thus on the basis of fourth edition scores the average female clerical and sales worker is scored as doing more complex work in relation to things than the average male clerical and sales worker.

In contrast to the clerical and sales sector the service and benchwork sectors—included here because they are also large employers of women—do not exhibit radically different patterns of upgrading for jobs held by men and those held by women, although they do show significant differences in the proportion of occupations in the third edition with no significant relationship to data, people, and things.

What do these results tell us about sex bias in the fourth edition DOT? Although no definitive judgment is possible in the absence of an external criterion of job complexity against which to assess the DOT ratings, the relative similarity in the mean scores for male and female workers is certainly consistent with an inference that these variables are largely bias free. For the total labor force, the means for the DATA variable vary by only about half a point, and the means for PEOPLE and THINGS by even less. Although the means are lower for men, indicating that they work in occupations with greater complexity than those held by women, the size of the differences is within what would be expected from well-known patterns of occupational segregation by sex. Hence there is no reason to believe that the kind of work women do is undervalued in the fourth edition DOT, at least with respect to the worker function ratings. Of course, the possibility exists that the work that women do is overvalued and that if unbiased scores were available, the mean difference between male and female workers would be even greater. However, this is unlikely, given other evidence demonstrating that men and women are equally well educated on the average and hold jobs with similar average prestige (Treiman and Terrell, 1975a, b), that the average GED levels of the jobs held by men and by women are virtually identical (the means are 3.14 and 3.20), and that the average SVP levels of the jobs held by men and by women differ by only about a half a point (the means are 4.70 and 4.14). These results imply that the worker function ratings in the fourth edition—but not the third edition—can be used to assess sex differences in occupational attainment without undue distortion (see chapter 4 for a discussion of such analyses).

CONCLUSION

This chapter deals with two major issues, the adequacy of the source data used to create the DOT and the adequacy of the data on occupational characteristics created in conjunction with the DOT. These issues are, of course, not unrelated, since the adequacy of the source data determines, in part, the adequacy of the resulting occupational characteristics scales. Still, it is useful to consider them separately.

The chapter documents the very uneven coverage of the labor force in the basic data collection process. First, the DOT includes many more production process occupations, relative to the number of individuals in the labor force employed in such occupations, than clerical, sales, and service occupations. While it may be that production process occupations are, in fact, more finely differentiated in the economy than are other occupations, there is no evidence that this is so. An equally plausible explanation is that DOT data collection procedures, which tend to concentrate on manufacturing plants, create a bias toward more detailed coverage of production process occupations than of other types of work. At present, there is no way of resolving this question, since there exist no principles for determining the boundaries of occupations and hence no

TABLE 7-15 Changes in the Scoring of DATA, PEOPLE, and THINGS Between the Third and Fourth Editions of the DOT[a]

	DATA		PEOPLE		THINGS	
	Male	Female	Male	Female	Male	Female
Total labor force						
Percent no significant relationship in 3rd edition	34.4	33.2	60.6	37.9	39.9	72.6
Mean in 4th edition, of those with no significant relationship in 3rd edition	5.41	5.34	7.23	7.38	6.21	4.76
Percent in lowest category in 4th edition, of those with no significant relationship in 3rd edition	75.8	68.1	61.6	68.9	92.7	82.9
Percent upgraded—3rd to 4th edition[b]	3.6	5.0	3.2	1.8	2.6	3.1
Percent constant—3rd and 4th edition	95.1	93.1	94.2	97.6	96.1	95.7
Percent downgraded—3rd to 4th edition	1.4	1.1	2.6	.6	1.3	1.2
Total mean—3rd edition[c]	3.97	4.51	6.58	6.28	5.13	6.92
Total mean—4th edition	3.10	3.63	6.14	6.22	4.39	4.55
Difference in means (4th minus 3rd)	−.87	−.88	−.44	−.06	−.74	−2.37
Clerical and sales						
Percent no significant relationship in 3rd edition	7.5	4.7	32.6	38.2	83.8	91.4
Mean in 4th edition, of those with no significant relationship in 3rd edition	4.50	5.03	7.10	7.08	5.87	3.60
Percent in lowest category in 4th edition, of those with no significant relationship in 3rd edition	24.1	51.9	55.5	54.5	75.7	31.9
Percent upgraded—3rd to 4th edition[b]	8.4	7.4	8.2	.7	.2	0.0
Percent constant—3rd and 4th edition	88.7	91.7	91.5	98.9	94.4	99.2
Percent downgraded—3rd to 4th edition	3.1	.9	.3	.4	5.5	.8
Total mean—3rd edition[c]	3.40	3.61	6.16	6.68	7.68	7.63
Total mean—4th edition	3.07	3.40	5.77	6.32	5.94	3.61

Difference in means (4th minus 3rd)	−.33	−.21	−.39	−.36	−1.74	−4.02
Service						
Percent no significant relationship in 3rd edition	75.5	82.9	55.7	29.1	37.9	64.0
Mean in 4th edition, of those with no significant relationship in 3rd edition	5.54	5.18	7.32	7.54	5.63	5.90
Percent in lowest category in 4th edition, of those with no significant relationship in 3rd edition	81.3	62.2	65.9	76.8	62.1	63.9
Percent upgraded—3rd to 4th edition[b]	0.0	0.0	1.8	1.5	0.0	.5
Percent constant—3rd and 4th edition	99.3	99.9	97.9	98.4	100.0	99.3
Percent downgraded—3rd to 4th edition	.7	.1	.2	.1	0.0	.2
Total mean—3rd edition[c]	6.56	7.03	7.18	7.17	6.09	6.67
Total mean—4th edition	4.72	4.71	6.78	7.02	5.19	5.32
Difference in means (4th minus 3rd)	−1.84	−2.32	−.40	−.15	−.90	−1.35
Benchwork						
Percent no significant relationship in 3rd edition	55.9	77.7	92.1	97.7	.3	0.0
Mean in 4th edition, of those with no significant relationship in 3rd edition	5.74	5.84	7.90	7.83	7.00	—
Percent in lowest category in 4th edition, of those with no significant relationship in 3rd edition	88.2	94.2	95.1	91.6	100.0	—
Percent upgraded—3rd to 4th edition[b]	4.3	8.1	0.0	0.0	7.1	7.1
Percent constant—3rd and 4th edition	91.3	85.7	96.2	100.0	90.7	89.8
Percent downgraded—3rd to 4th edition	4.4	6.2	3.8	0.0	2.2	3.0
Total mean—3rd edition[c]	5.48	6.68	7.64	7.92	3.32	3.47
Total mean—4th edition	4.33	5.38	7.55	7.76	3.18	3.37
Difference in means (4th minus 3rd)	−1.15	−1.30	−.09	−.16	−.14	−.10

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[a] Data from an April 1971 Current Population Survey of a representative sample of the adult labor force, $N = 60,441$.

[b] Percent assigned a higher complexity level (a lower score) in the 4th edition than in the 3rd edition, excluding those with no significant relationship in the 3rd edition. Percent constant and percent downgraded similarly defined.

[c] Mean is computed on entire sample, including those with no significant relationship, a score of 7 or 8 on DATA, 7 on PEOPLE, and 8 on THINGS.

unambiguous procedures for aggregating jobs into occupations. The development of such principles and of procedures for using them in the data collection process should be given high priority in preparation for future editions of the DOT.

Second, some occupations in the fourth edition DOT were analyzed many times, while others were not analyzed at all. Given the heterogeneity of jobs included within a single occupational category (which is confirmed by the substantial "job description" effect on the reliability of worker trait and worker function ratings), procedures need to be developed to ensure a more even sampling of jobs within occupations in order to be certain that each occupational description is based on data from a sufficient number of job analyses to produce representative data.

What constitutes an "occupation"—and how much heterogeneity in the content of a set of jobs justifies a single occupational title—is a difficult question. Historically, the DOT has tended to define occupations by their titles rather than by their content. Jobs with similar titles have been grouped unless the evidence strongly indicated that they differed in content, and occupations with different titles have been defined as being different, regardless of similarity in content. At the same time, each job analysis tends to produce a new DOT occupation, while jobs with titles similar to titles already existing in the DOT tend not to be analyzed at all, making it impossible to determine their degree of similarity. Occupational titles are also used inconsistently in the DOT to define very specific or very heterogeneous groups of jobs. Branch manager, for example, describes a wide variety of jobs, all of which involve coordination and control functions but vary enormously in terms of the specific tasks performed. Tool and Die Maker, by contrast, describes basically the same job regardless of where tool and die makers are employed.

Consideration should be given to developing a clear and unambiguous way of defining occupations.

The analysis in this chapter also raises serious questions regarding the adequacy of the worker trait and worker function variables. First, it is unclear whether the 46 variables on which data are collected adequately represent the kind of information needed by users within and outside the Employment Service. Our conjecture is that they do not. Many of the DOT variables, especially the aptitudes, interests, and temperaments, are not heavily used, as we have seen in chapters 3 and 4. Oddly, other information collected on job analysis schedules but never subsequently recorded, i.e., information on promotion ladders and lateral transfer routes, is often mentioned by users outside the Employment Service as a major lack in the DOT. Obviously, consideration should be given to the inclusion of such information in the DOT occupational descriptions. More generally, a careful conceptual review should be undertaken of the sort of information needed for matching workers with jobs (e.g., data on the transferability of skills), for counseling job applicants about occupational requirements, for assessing the comparability of occupations for the resolution of equal employment opportunity disputes (better data on the responsibilities entailed in occupational performance, for example), and for occupational research of various kinds. Once the major dimensions of occupations on which data are needed are identified, scales measuring these dimensions should be developed following standard psychometric practices. In particular, consideration should be given to the development of factor-based multiple-item scales, the use of which would go a long way toward overcoming the reliability problems identified in Appendix E and summarized in this chapter.

Despite the deficiencies in the fourth edition worker trait and worker function variables identified here, they remain the most comprehensive set of occupational characteristics currently available. As such, their use should be encouraged. To facilitate this use, Appendix F provides data on eight DOT variables aggregated to match the categories of the 1970 U.S. Census detailed occupational classification and four factor-based scales derived from the DOT variables. Researchers should find these data a useful supplement to data on the average characteristics of workers that can be derived from census occupational statistics. Moreover, one potential major threat to the usefulness of these data can be discounted on the basis of our analysis: so far as we can tell, the fourth edition worker function variables do not undervalue occupations held mainly by women as the third edition worker function variables apparently did.

8 The Classification of Occupations: A Review of Selected Systems

THE CLASSIFICATION STRUCTURE OF THE DOT

The purpose of the DOT occupational classification system is to organize occupations into groups that are similar in the sense that they tend to make similar demands on workers or in which workers with specific qualifications or characteristics are likely to find satisfactory employment. The first edition DOT noted in its foreword (p. xi):

> As a product of the [Employment Service] Research Program, [the DOT] is part of a directed effort designed to furnish public employment offices in this country with information and techniques that will facilitate proper classification and placement of work seekers.
>
> Getting qualified workers into appropriate jobs is a task that can be done most adequately when the transaction is based on a thorough knowledge of both worker and job. . . . Thus, it becomes part of the duties of public employment offices to learn as much as possible about jobs and workers in order to be able to act as an effective placement agency. If a foundry superintendent wants the public employment office to send him a cupola tender, the office must know enough about the work and worker to be able to refer a registrant who has been previously classified as qualified and capable of doing the work required.

The DOT was developed to provide Employment Service interviewers and counselers with the information necessary to classify workers and jobs appropriately in order to match them.

The fourth edition DOT reflects the continued primacy of job-worker matching as the reason for its existence. The first sentence of its introduction lists job matching as the primary justification for producing the DOT (p. xiii):

> The *Dictionary of Occupational Titles* is an outgrowth of the needs of the public employment service system for a comprehensive body of standardized occupational information for purposes of job placement, employment counseling and occupational and career guidance, and for labor market information services. In order to implement effectively its primary assignment of matching jobs and workers, the public employment service system requires a uniform occupational language for use in all its offices. This is needed to compare and match the specifications of employer job openings and the qualifications of applicants who are seeking jobs through its facilities.

CREATING OCCUPATIONAL TITLES

The process by which the millions of jobs in the economy are grouped into the occupational titles in the DOT is crucial in determining the usefulness of the DOT as a matching tool. The fourth edition DOT describes this process in general terms (p. xv):

> Work is organized in a variety of ways. As a result of technological, economic and sociological influences, nearly every job in the economy is performed slightly differently from any other job. Every job is also similar to a number of other jobs.
>
> In order to look at the millions of jobs in the U.S. economy in an organized way, the DOT groups jobs into "occupations" based on their similarities and defines the structure and content of all listed occupations. Occupational definitions are the result of comprehensive studies of how similar jobs are performed in establishments all over the nation and are composites of data collected from diverse sources. The term "occupation," as used in the DOT, refers to this collective description of a number of individual jobs performed, with minor variations, in many establishments.

The process of arriving at the 12,099 occupations defined in the fourth edition involves two steps, which are described in detail in chapters 6 and 7. First, on the basis of actual observation of workers in a number of positions, a job description is written by completion of a job analysis schedule. Then the job descriptions are grouped into occupations, and composite descriptions are prepared for inclusion in the DOT. Conceptually, these two steps are similar; both "job" and "occupation" are theoretical entities. The central question in creating these entities is how to delineate the boundaries, by deciding how much heterogeneity should be tolerated within them.

The same kind of question arises in the next step in the process: arranging the 12,099 occupational definitions into a classification structure. The remainder of this chapter is devoted to this topic.

GROUPING OCCUPATIONS

Traditionally, the Employment Service has used the occupational titles in the DOT in a relatively straightforward manner to match available jobs and workers. For example, those who indicate that they are plumbers (or have worked as plumbers) are matched with any openings for plumbers on file at the local Employment Service office. The matching procedures are relatively uncomplicated if there are job openings for plumbers (and if the plumber is satisfied with one or more of the available positions).

A more difficult question arises when there are no openings in the occupation in which a worker is classified. In such instances the Employment Service either must send the worker away without offering him or her any opportunity for employment or must make fundamental decisions about the similarity of occupations and accurate estimates about the degree of transferability of the worker's skills and experience in past occupations to one or more alternative occupations. Interviewers apparently do this quite frequently. As we have already noted, assessing the transferability of skills goes beyond the paradigm for job-worker matching that originally motivated the DOT and was expressed in its first edition; the underlying principle is, however, extremely important.

Workers typically can perform in many occupations besides the ones in which they have previously been employed; moreover, many skills are learned on the job. It may be that for a large number of jobs, previous work experience is more or less irrelevant. Among the 12,099 occupations described in the DOT we find a great many that appear to involve similar skills and aptitudes. For example, workers who have experience as a Landscape Laborer (408.687-014) may be reasonable referrals for occupations such as Laborer, Brush Clearing (459.687-010) and Laborer, Golf Course (406.683-010). We note, however, that these occupations are not grouped together in the DOT's classification scheme.

Since the DOT classification is used to organize files of job openings and applicants in local Employment Service office job banks, the location of occupations in the classification structure will effectively determine to which job openings a job seeker is exposed. This is particularly the case if the lists of job openings are extensive, as they are in large labor markets. The Landscape Laborer (408.687-014) mentioned above might have to search through listings for many jobs before coming upon an opening for a Laborer, Brush Clearing (459.687-010). To the extent that any ordering scheme makes it easier to locate an appropriate job, it obviously increases the employment opportunities of workers, especially since (in the offices we visted) more than 70 percent of all Employment Service job referrals are made by workers themselves finding appropriate job openings in the lists maintained by the employment office.

It is simple to observe that a system that directs landscape laborers only to openings in that field and does not refer them to employment opportunities in related areas is overly restrictive. It is a far less simple matter to develop a general solution to this problem. The difficult question is how to decide, in general, what constitute reasonable occupational referrals. How does one decide what occupations are similar? How can one expand the employment opportunities of workers who seek work at the local Employment Service offices?

Two plausible approaches to these questions are embodied in the classification structure of the fourth edition DOT. First, occupations are organized in groups essentially according to technologies; 559 of these occupational groups are represented by the first three digits of the DOT occupational code. Second, each occupation is also characterized by the requirements it places on workers in terms of their interaction with data, people, and things; these requirements are represented by the second three digits of the code. Either set (or both sets together) of digits could be viewed as a reasonable index of the similarity of occupations, although it is important to note that neither has ever been validated against an external standard. In the fourth edition the occupational titles and their definitions appear in order according to the numerical DOT codes. This ordering means that the technologically defined groups have precedence in the classification system over the worker function groups.

The DOT Code: The First Three Digits

The occupational groups represented by the first three digits of the code appear to have been developed in an ad hoc manner—by considering a composite of industry; work field; machines, tools, equipment, and work aids (MTEWA);[1] and materials, products, subject matter, and services (MPSMS). (See chapter 6 and U.S. Department of Labor (1972:5–7) for a detailed discussion of these concepts.) In assigning the first three digits to an occupation, the job analyst or the definition writer is instructed to consult the DOT's existing classification, particularly the narrative descriptions of the major categories and divisions, in order to identify in which of the 559 occupational groups the occupation belongs. This process involves a good deal of judgment, since some of the categories are very similar. In the absence of more specific guidelines, the DOT code may be assigned in a somewhat arbitrary manner. Moreover, reliance on the existing classification of the third edition DOT as the bench mark for the assignment of category codes in the fourth edition undoubtedly discouraged rearrangements of the classification and changes in codes. While definition writers for the fourth edition could in principle recommend that categories be combined or eliminated or that new ones be created, there is no documentation of such recommendations.

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[1] In the work field "logging," for example, the following descriptions of tasks are suggested: "Climbs tree, using climbing spurs and safety rope, and cuts limbs, knots, and top from tree with ax and handsaw" (U.S. Department of Labor, 1972:89).

The DOT Code: The Second Three Digits

The third edition DOT and various trial matching programs used the worker function scales (the second three digits of the DOT code) to identify occupational groups,[2] but the fourth edition makes no attempt to do so. Attempts to classify occupations solely on the basis of their complexity in relation to data, people, and things have been generally unsuccessful. An automated matching system based on worker function codes did not work out, nor did a manual matching attempt in Pittsburgh during the experimental period prior to publication of the third edition.[3]

Despite the failure of the worker function scales to serve as an adequate basis for matching, the concept is probably useful in developing a classification system for matching. The worker functions are intended to summarize characteristics of workers required by the job (such as their interests and aptitudes).[4] They were developed from a realization that every job is actually a job-worker situation and that to describe such a situation adequately, knowledge of the characteristics of both the job and the worker is required. The worker traits required by a job are not

[2] The 22 major categories of the worker function scales, called areas of work, appear to have been developed in an *ad hoc* manner. Within each category, occupational groups of related worker function codes are created, but the correspondence of groups to codes is not unique. The same worker function code (e.g., .288) often appears in many different groups. This is perhaps not surprising, since worker function codes attempt to measure the complexity of the job and omit reference to specific skills, which are often important in placement.

[3] Interview, Adaline Padgett, occupational analyst, Division of Occupational Analysis, U.S. Employment Service, August 1979.

[4] In their description of the Functional Occupational Classification Project, Fine and Heinz (1958) recount the process by which all the occupational measures created for a group of 4,000 experimental occupations were used as bases for sorting the data into groups of similar occupations; they concluded that the worker functions form the best groups because the profile of the occupations on all the other variables was fairly consistent within worker function groups, at least more so than for groups formed on other bases. It should be pointed out that the techniques for discerning common patterns in data have advanced significantly since the mid-1950s when this research was done. Fine and Heinz sorted the data repeatedly in a search for consistent patterns.

captured by the considerations that currently enter into determining the first three digits of the DOT codes, which appear to be based primarily on technological processes.

Summary

Because the transferability of skills is generally regarded as the most appropriate criterion for assessing the similarity of occupations with a view to matching jobs and workers, the two aspects of the classification structure inherent in the DOT codes (the first and second sets of three digits) were ostensibly designed to capture two important elements of the transferability of skills. The first element is job-specific knowledge or skills—the technological aspects of the occupation, the particular subject matter, and the materials and equipment used. These are described by the first three digits of the DOT code. The second element involves the qualities of workers that are required by jobs. These are thought to be captured by the worker function codes (the second three digits) because the worker function configurations "profile" a variety of worker traits consistently. These two bases of classification of the occupational titles in the DOT are conceptually quite appropriate in the judgment of the committee. The implementation of these concepts in practice, however, appears to be somewhat inadequate, and it remains an open question whether these two elements of the transferability of skills could not be better tapped by indicators based on other methodologies.

THE KEYWORD SYSTEM OF THE EMPLOYMENT SERVICE

More an alternative mechanism for matching job applicants with job openings than an alternative classification system, an automated keyword system has been implemented in a number of Employment Service offices throughout the country. This system was the subject of a limited staff review, reported in Appendix G. The main conclusion that should be drawn from this review is that although automation of the matching process is highly desirable, the keyword system as it is currently implemented suffers severe difficulties and needs to be thoroughly reviewed by a committee of experts, a task that goes beyond the charge to our committee.

EXISTING ALTERNATIVE CLASSIFICATIONS FOR JOB-WORKER MATCHING

Several alternative methodologies for constructing occupational classifications have been developed in recent years. The task inventories and the Position Analysis Questionnaire (PAQ) techniques described below may be especially useful in identifying the types of skill components involved in particular tasks and jobs. The identification, measurement, and classification of skills is at the heart of the problem of person-job matching. With a thorough understanding of the skills required by a broad variety of jobs as well as sound measures of those skills, it might be possible to develop taxonomies of persons and occupations that would facilitate differential placement, counseling, guidance, and education (see Altman, 1976; Canada Employment and Immigration Commission, Occupational and Career Analysis and Development Branch, 1978; McKinlay, 1976). The feasibility of developing classifications based on knowledge of skill content, at least in certain fields of work, is illustrated by descriptions of certain military occupations (Morsh, 1966). The PAQ data for 746 jobs have been used to create job families based on worker-oriented dimensions of skill, omitting the technological aspects (Shaw et al. (1977); also see Colbert and Taylor (1978), Taylor (1978), and Taylor and Colbert (1978)). Another inventory, the Occupational Analysis Inventory, has been used to group 1,414 jobs into 21 clusters (Pass and Cunningham, 1976).

Classifications based on job dimensions derived from structured job analysis or task inventories, when combined with taxonomies of human performance (Fleishman, 1975), appear to provide another way to address directly the issue of the suitability of workers' skills, abilities, or other characteristics for specific categories of jobs. As Dunnette (1976:516) notes, there now exist several methods for describing or predicting how efficiently different persons may be expected to perform various work functions:

> Further research . . . should focus on developing . . . short, easily administered, and easily understood behavior description inventor[ies] which may be used as a common basis for classifying jobs, tasks, job dimensions, human attributes, aptitudes, skills, and tests and inventories into the same taxonomic system.

Because of the level of detail involved in inventory approaches, research has been limited so far to a few work areas. Many more areas would have to be studied to make these techniques generally useful in developing classifications for person-job matching purposes. Despite this limitation the inventory approach is one that appears to be worth pursuing.

Counseling psychologists have attempted to create classifications of workers and jobs of the sort suggested by Dunnette. The resulting systems for person-job matching do not involve as much detail as do the task inventory approaches and are also more indirect, usually relying on the characteristics of persons rather than the characteristics of the work itself for the development of the matching scheme. Two attempts, the

Minnesota theory of work adjustment (Borgen et al., 1972; Dawis and Lofquist, 1974, 1975, 1976; Lofquist and Dawis, 1969; Rosen et al., 1972) and Holland's theory of careers (Holland, 1966, 1968, 1973a, 1976; J. Holland and G. Gottfredson, 1976; Holland et al., 1972) use classifications of occupations to explain vocational adjustment and vocational choice, respectively. These two schemes are of interest for three reasons: First, both theories have developed occupational classifications for the specific purpose of matching workers with jobs. Second, both theories incorporate independent but parallel classifications (Holland) or characteristics (Minnesota) of persons and occupations and explicit procedures for specifying the degree of match between a person and a number of occupations. Third, both perspectives have generated substantial research.[5]

MINNESOTA THEORY OF WORK ADJUSTMENT

According to the Minnesota theory, the greater the correspondence between a person's abilities and the patterns of aptitudes required by a job, the better his or her performance (satisfactoriness) and the greater his or her persistence in the job. Similarly, correspondence between a person's "needs" (values, interests) and patterns of occupational reinforcers leads, according to the theory, to job satisfaction and persistence. Recently, Dawis and Lofquist (1974, 1975) have also used occupational aptitude pattern clusters and occupational reinforcer pattern clusters to form a classification of occupations and have shown how this classification is related to the DOT and Holland classifications.

In general, the evidence about the usefulness of the Minnesota theory implies moderate support for the theory and its associated tools (Betz et al., 1966; Elizur and Teiner, 1977; Weiss et al., 1965, 1966). The theory predicts satisfaction more efficiently than performance, and researchers have found relatively stable differences among occupations in their patterns of reinforcers and aptitude requirements. It is also clear that predictions of performance (satisfactoriness, satisfaction, and persistence) are relatively inefficient, even with the aid of this elaborate and carefully constructed set of tools for person-job matching. These relatively weak predictions of important job-related criteria are not, however, limited to this particular theory. In this area of research, strong statistical associations between predictors and criteria are rare (Dunnette, 1976; Ghiselli, 1973; Schletzer, 1966).

[5] For reviews, summaries, critiques, and important tests, see Osipow (1973), Walsh (1973), McCormick (1979), McKinlay (1976), L. Gottfredson (1978), and Rounds et al. (1978).

The major limitations of the Minnesota theory are twofold. First, it relies on a number of indirect approaches to the determination of job characteristics, inferring them, for example, from employee or supervisor ratings or from the characteristics (especially abilities) of workers who are employed in an occupation. Second, the range of occupations for which occupational reinforcers and aptitude patterns are available is currently limited; data for only 148 occupations are available. Nevertheless, the Minnesota work demonstrates that, in principle, it is possible to engineer the independent assessment of persons and jobs in parallel ways so that the degree of worker-job match can be estimated. Such an approach could prove effective in capturing the two elements of skill transferability noted above, particularly the qualities of workers that are required by jobs.

HOLLAND CLASSIFICATION OF CAREERS

The second counseling approach to person-job matching is illustrated by Holland's (1973a) theory of careers. Holland has developed a typology of persons and occupations that includes six types: realistic, investigative, artistic, social, enterprising, and conventional. Inventories such as the *Vocational Preference Inventory* (Holland, 1978), the *Self-Directed Search* (Holland, 1973b), the *Strong-Campbell Interest Inventory* (Campbell, 1977), or *l'Inventoire Personnel* (DuPont, 1979) are used to locate individuals in this typology, and, in turn, the modal characteristic of incumbents in a particular occupation is used to characterize that occupation.[6] For counseling purposes, matches are made between the personalities of individuals and this characterization of occupations. Underlying the Holland classification is the notion that vocational choices are expressions of personality; thus there should be greater similarity between the personalities of incumbents of the same occupation than between incumbents of different occupations. Person-job congruence is said to exist when the personality type that a person most resembles accords with the category into which a given occupation falls. Congruence leads, according to the theory, to satisfaction, success, and stability or tenure in an occupation.

[6] Often, when data on profiles of job incumbents are unavailable, Holland and his colleagues resort to indirect approximations involving a substantial degree of judgment in classifying occupations. Use has been made of *Strong Vocational Interest Blank* data, *Kuder Preference Inventory* data, PAQ data, and observations of regularities between the Holland occupational classification and the DOT classification (Holland, 1973a; Holland et al., 1972). Approximation techniques exist for assigning a Holland category to all 1960 and 1970 census occupations (L. Gottfredson and V. Brown, 1978) and to all third edition DOT titles (Viernstein, 1972).

Tests of Holland's theoretical formulations have had mixed results. On one hand, despite the amount of subjective judgment involved in the classification of occupations, the occupational classification shows strong relationships of expected kinds with the Minnesota occupational reinforcer scales; the DOT worker functions, SVP, and GED ratings; self-direction; and prestige (L. Gottfredson, 1978; Rounds et al., 1978). The Holland occupational classification has also been shown to be efficient in organizing occupational mobility data in that the category of a worker's later job is substantially predictable from knowledge of the category of a worker's earlier job for those who change jobs (G. Gottfredson, 1977; Holland et al., 1973; Nafziger et al., 1974). Finally, evidence verifying the dimensions of vocational interests that underlie Holland's classification of persons implies that his groupings are reasonably sound (Guilford et al., 1954; Hanson and Cole, 1973; Nafziger and Helms, 1974).

On the other hand, the classification appears to be most useful when it is supplemented by a general measure of occupational level such as the GED. It focuses primarily on occupational preferences, and the measurement of occupations is indirect. The occupational classification resembles in some ways the approach to development of the *Occupational Ability Patterns* of Dvorak (1935) and Patterson and Darley (1936) during the depression, paying little direct attention to the details of the work performed or the skills required to perform them. Also, it organizes occupational mobility and congruence data better for older than for younger people (G. Gottfredson, 1977; L. Gottfredson, 1979).[7] Variation in the methods used to classify occupations or persons results in slightly different classifications ("identifications" in Sokal's (1974) terms).

Moreover, Holland's theory is incomplete with respect to the roles played by social class, intelligence, and special aptitudes in the allocation of persons to jobs. The theory incorporates a number of secondary propositions about the degree of congruence among the personality and occupational types that have not been discussed here (see Holland, 1973a). In general, the research tests of these secondary propositions have yielded weak support (G. Gottfredson, 1977; Nafziger et al., 1974; Rounds et al., 1978). The proposition that congruence leads to success in an occupation is largely untested, and the evidence that congruence leads to job satisfaction is very weak (see the studies cited by Rounds et al. (1978)).

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[7] Perhaps this reflects the fact that individual traits change over time as a result of occupational experience, in such a way as to create greater conformity between individual and occupational characteristics (Kohn and Schooler, 1973).

SUMMARY

In short, the Holland and Minnesota approaches to person-job matching illustrate the value of independent but parallel assessments of persons and jobs and of the resulting occupational classifications, but both approaches employ limited mechanisms for the assessment of actual job content and skill requirements. An approach to occupational classification that seeks a middle ground between the extreme specificity of task analysis and the detailed examination of human abilities exemplified by Fleishman's (1975) work, on one hand, and the more global but indirect approaches to the parallel classification of persons and jobs illustrated by the Holland and Minnesota schemes, on the other, may be a fruitful approach to the improvement of the classification of occupations for the purpose of matching workers and jobs.

A MOBILITY-BASED APPROACH TO JOB-WORKER MATCHING

The transferability of skills between occupations should be the primary basis for classifications whose purpose is job-worker matching. The mobility that occurs in the labor market, specifically the changes between occupations that workers sometimes make when they change jobs, provides one indicator of the transferability of skills between occupations. If workers move frequently back and forth between a pair of occupations, we can infer that the occupations require similar aptitudes and skills, or at least that those who perform one occupation are generally capable of performing the other; otherwise, transfers would not occur.[8] Classifications that have been developed for the purpose of job-worker matching should group together those occupations among which workers commonly transfer. As we have seen, in the DOT classification many jobs that appear to require similar skills are placed in widely different occupational categories. For example, Dispatcher, Radio (379.362-010) is classified as a protective service occupation, while Dispatcher, Traffic or System (919.162-010), which involves essentially the same skills, is classified as a miscellaneous transportation occupation. Similarly, Engraver, Hand, Hard Metals (704.381-026) is classified as a benchwork occupation, while Die Maker (979.281-010), which involves similar tasks, is classified as a miscellaneous occupation.

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[8] Obviously, one-way transfers must be treated more cautiously, since they may represent promotion ladders. It would not be desirable, for example, to send an assembly line worker to an opening for foreman even though foremen are almost entirely drawn from the ranks of line workers. In practice, however, this is not much of a problem, since supervisory personnel are almost always promoted from within. See Appendix H for a discussion of ways to use unidirectional transfers to infer career ladders.

Naturally occuring mobility between occupational categories is a sufficient but not necessary indicator of the transferability of skills. There are many jobs between which mobility does not occur despite similarity in content, because of custom, discrimination, or other reasons (McKinlay, 1976). For example, women who are secretaries move into managerial jobs only rarely, primarily because of tradition and prejudice, even though secretarial skills such as planning and coordinating may be highly relevant to many managerial jobs. Hence it would be unwise to rely on mobility patterns as the only or even the primary basis for assessing occupational similarity.

However, a mobility approach may provide a useful supplement to traditional methods of assessing the similarity of occupations and the transferability of workers, by providing an empirical criterion for judging the similarity of occupations and the substitutability of labor.[9] Whereas the classifications we have reviewed above rely mainly on analysts' judgments regarding the similarity of jobs, in the mobility approach, occupations are grouped solely because of high degrees of movement between them. The nature of occupations need not be analyzed in order to identify similarities to be used as a basis for classification; it is necessary only to locate movement among occupations, whatever their nature. (The mobility approach must, however, rely on other approaches to define the basic occupations; 100 million positions in the economy must first be classified into a reasonable number of occupational titles before movement between occupations can be assessed.) In this section we describe the potential of mobility data as a basis for constructing classifications and enumerate the advantages and disadvantages of this approach.

We have undertaken some exploratory analyses to assess the feasibility of developing alternative classifications based on the available job mobility data. Basically, we attempted to group in clusters those jobs between which the rates of transfer were high. Technical details of these analyses are provided in Appendix H; for similar work, see Dauffenbach (1973). Our analyses have led us to several general conclusions:

1. Mobility data can be useful for constructing an occupational classification that is useful for placement, but the basic occupational titles for which mobility data are collected must be defined by other procedures. Occupational mobility data can contribute little to the definition of

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[9] See Roe et al. (1966) and Holland et al. (1973) for earlier studies of classifications using mobility data.

occupations as clusters of similar jobs. For this work other methodologies such as job analysis or task analysis are required.

2. Some plausible statistical models for transfers are available and can be used as a guide in evaluating and generating classifications and career ladder orderings.

3. It is technically feasible to construct occupational categories so that most transfers take place within relatively small groups and according to career ladders. Computations for developing such a classification might cost several hundred thousand dollars if the full set of 12,099 DOT titles were used. New algorithms would have to be developed.

4. It is technically feasible to apply this kind of analysis to the job history data currently gathered from Employment Service clients, since these job histories are routinely assigned DOT codes.[10]

5. Classifications based on observed transfers among occupations suggest hypotheses about how the observed mobility has come about. Independently generated data on task and skill similarities, and also on the social characteristics of incumbents of occupations (e.g., age, sex, and race), could be used in conjunction with data on mobility rates to further our understanding of how people move among jobs.

6. Because some transfers may be excluded (or included) for reasons other than those having to do with the transferability of skills, such classifications should not be used uncritically. It is necessary to examine the job content of the occupational categories suggested by the mobility-based clusters in order to include any additional potential transitions and in order to exclude absurd clusters created as artifacts of the statistical algorithm.

ADVANTAGES AND DISADVANTAGES

The mobility approach to developing placement-oriented classifications has several advantages. First, it can be developed from data already collected by the Employment Service, which in its day-to-day operations routinely collects work histories from applicants. For each local labor market and for the specific clientele they deal with, the Employment Service collects all the data needed to find out what occupational linkages commonly occur. Second, the mobility approach allows for great flexibility and continuous improvement. Since the underlying mobility matrices can be continuously updated by using data from the ordinary operations of the Employment Service, classifications for matching can be altered as labor market conditions change. For example, by using regularly updated transition matrices for a local labor market, the procedure could reflect the fact that the opening of a new automobile assembly plant had created new employment opportunities for workers formerly employed as coal miners. Third, this method avoids the *ad hoc* judgments of program designers, occupational analysts, or vocational counselors in deciding what are similar and dissimilar occupations for the purpose of job referral; it relies instead on the actual experiences of workers as they test various alternatives in the labor market. Fourth, the approach would overcome problems inherent in the overly narrow occupational classifications of the DOT, since all occupations between which workers routinely transfer would be grouped together.

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[10] To be useful, these data would have to be preserved as a nine-digit occupational code. At present, the third through ninth digits are discarded when the interview data are keypunched.

The mobility approach, however, is not without its disadvantages. First, as noted earlier, the resulting categories will reflect in part the current practices of employers rather than the potential possibilities for transfer inherent in the nature of transferable skills among occupations. Employers may perpetuate, even unwittingly, discriminatory or stereotyped hiring practices, or they may fail to perceive the potential of workers to move into new occupations. To the extent that this occurs, the use of a classification based on actual transitions will continue to perpetuate these undesirable limitations on workers' employment opportunities. Second, and analogous to the first disadvantage, the resulting classification will reflect in part the current preferences and possibly limited horizons of job seekers themselves. Such a classification might not expose workers to what has not been tried before. Third, if the resultant groupings are based on data generated by Employment Service activity, they will reflect in part the practices of the Employment Service itself. When workers with particular occupational histories are referred most often to job openings in certain other occupations on the basis of currently used classificatory practices, these patterns in referral practices will naturally tend to appear also in data on placements. Fourth, the reliance on job histories to provide mobility data may result in classifications that meet the needs of new entrants and labor market reentrants inadequately. Fifth, regularities in occupational transfers per se may tell us little about the desirability of the transfers from the point of view of either the employer or the employee. Placements may differ in terms of stability or tenure of employment, productivity or performance, and employee satisfaction or employer perceptions of satisfactoriness. Classifications based on mobility data may group together, then, placements of differing usefulness; such classifications do not provide information on the likely quality of the matches, though labor market information (such as job tenure) could be used to supplement the classification.

STRATEGIES FOR IMPROVING OCCUPATIONAL CLASSIFICATION FOR JOB-WORKER MATCHING

These disadvantages suggest that the mobility approach to developing placement classifications must be supplemented by other information. First, and most crucial, a reliable set of occupational definitions is necessary to provide the data base for mobility studies. Job analyses, then, must continue to be the basic building materials of classification systems. Second, because of current limitations on labor market mobility, additional indicators of the transferability of skills must be developed in order to encourage employers, workers, and the Employment Service to try new types of matches. Again, job analysis approaches are appropriate, as are vocational counseling approaches. Moreover, mobility patterns might be studied to identify groups of occupations for which specialized approaches such as task analysis would be particularly useful. Third, because without supplemental information the mobility approach treats all matches as being equally good, additional information about the quality of the matches must be developed. There are two plausible approaches to developing this information. The quality of the match could be inferred from labor market data on, for example, the average job tenure of particular types of matches (e.g., coal miners in steel mills), or the quality of matches could be assessed by directly querying workers and employers. Either approach could contribute to improving the quality as well as the quantity of matches. Fourth, mobility data must be supplemented by information about new entrants and returning workers. Direct skill and ability assessment will continue to be useful in developing placement possibilities, not only for those with limited labor market experience but also for those workers who want to change careers.

OTHER METHODOLOGIES

Among the other alternative methodologies that may provide independent assessments of occupational similarity, a prime candidate is task analysis (including task inventories and position analysis questionnaires). Similar in many respects to traditional job analysis, task analysis aims to describe occupations in terms of the types of job tasks that are performed. It differs from job analysis in both the explicitness of its attempt to assess the similarity of occupations and its method of measurement. Task analysis has been extensively used by the military services and to a lesser extent by other government agencies such as the Public Health Service. By using data rating the extent to which various jobs involve a common set of tasks, it is possible to apply clustering and scaling procedures to construct a simplified description of the similarity of these jobs. The resultant description may be used to construct a classification of jobs in which similarity is taken to mean similarity in task content. This procedure could provide an alternative perspective to the mobility approach to the similarity of occupations.

Worker characteristics can also be used to assess the similarity of occupations. As we note above, classification systems developed by Holland in his theory of careers or in the Minnesota theory of work adjustment tap important dimensions of occupational similarity. Moreover, the techniques developed by vocational counselors to assess the quality of matches from the point of view of both workers and employers provide useful tools to assess the success of various classification schemes in generating appropriate placements. These techniques are also useful in providing knowledge of the skills, abilities, and aptitudes of workers that supplement knowledge gained from job histories; they will thus be particularly important for new entrants, reentrants, and those wishing to explore different areas of work.

Classifications that are truly ideal for placement must make use of a variety of approaches. Further research on developing classifications for job-worker matching is particularly necessary along two lines. First, the use of mobility data to indicate the transferability of skills and to locate plausible job-worker matches should be investigated further. Second, methods for assessing worker characteristics, such as skills, aptitudes, and interests, and indicators of the adequacy of matches, such as satisfaction, performance, and persistence, should be investigated.

A RESEARCH PROGRAM FOR DEVELOPING CLASSIFICATIONS

A research program intended to develop or improve classifications for placement purposes might evaluate several aspects of the resulting classifications:

1. What heuristic value do the classifications have for contributing to an understanding of the transferability of skills, barriers to labor market mobility, or the segmentation or Balkanization of labor markets in both desirable or undesirable ways?
2. How successful are the classifications in generating satisfactory placements? What proportion of job referrals made using a classification or matching scheme results in placements (i.e., employer decisions to hire and applicant decisions to accept employment)? How long do the placements last? Do persons referred to jobs continue working at those jobs for an acceptably long period of time? Put another way, do alternative matching

procedures make any difference for the employment stability of users of the Employment Service?

3. What are the long-range outcomes of placements made in terms of the income, job satisfaction, and performance of the persons placed?

4. How easy is it for employment interviewers, applicants, and employers to understand and use each system?

5. Are different classifications useful for different aspects of job-worker matching?

CONCLUSION

In this chapter we have reviewed the classification structure of the DOT as well as alternative bases for systems of occupational classification and have raised some of the conceptual issues involved in developing classifications for job-worker matching, in particular the notion of occupational similarity and the transferability of skills. We have suggested the use of data on naturally occurring patterns of labor mobility to evaluate, refine, and develop new occupational classifications.

Our analyses lead us to conclude that mobility-based methods may provide a flexible methodology for evaluating and developing classification systems for use in placement. They have the unique advantage of using the actual histories of workers in the labor force as guides for defining what are appropriate (and inappropriate) matches to make for individuals with a given occupational background. This method avoids *ad hoc* judgments and permits greater flexibility than previous centralized, once-a-decade exercises in occupational grouping.

Nonetheless, our work also indicates a clear need for more traditional occupational analysis procedures. At a minimum, such procedures are needed to define the basic occupational titles. There are, however, other important reasons for shunning excessive reliance on mobility data in making placement decisions. Any history of occupational mobility reflects not only the potential range of the transferability of workers' skills between various occupations but also the patterns of discrimination in hiring and promotion that now exist (or previously existed) in the labor market. So, for example, the fact that administrative secretaries do not commonly advance into management occupations may reflect patterns of sex discrimination in hiring and promotion rather than any inherent lack of transferability of their skills. Any placement system guided exclusively by the history of labor mobility between occupations would build the past biases of the market into its future operations.

These considerations dictate that any mobility-based approach to describing the similarity of occupations should be supplemented by other methods that do not depend on the past functioning of the labor market. An independent perspective on the similarity of occupations is required. Traditional occupational analysis procedures might play this role, although job analysis as currently practiced in the occupational analysis program has not been especially successful in defining the similarities of disparate occupations. In an approach that emphasizes required worker characteristics, the most ambitious attack on this problem has been the ratings measuring the complexity of a job in relation to data, people, and things of the occupational analysis program's functional job analysis approach. The validity of these ratings has not been studied systematically, however, and their relationship to the potential transferability of workers from one occupation to another remains to be shown. Moreover, as chapter 7 indicates, the reliability of these measurements is questionable. Any attempt to apply these particular measures as independent indicators of occupational similarity should be grounded in future studies of their criterion-related validity[11] and ongoing quality control of their measurement.

Other alternative methodologies that should be explored are task analysis or other forms of structured job analysis and person-job matches based on vocational preference theories such as that of Holland. The integration of (1) task analysis data obtained from representative samples of workers, (2) direct observation of jobs using more traditional job analysis procedures and the judgments of trained analysts, and (3) the assessment of workers' traits and person-job matches using techniques developed by vocational counselors, with (4) study of the naturally occurring patterns of labor mobility would provide a more adequate basis for developing classification systems and operational procedures for use by the Employment Service in matching jobs and workers.

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[11] Criterion validity could be demonstrated by showing the relationship, if any, between the ratings of occupations on DATA, PEOPLE, and THINGS variables and the ease with which workers transfer between jobs in these occupations

9 Conclusions and Recommendations

The charge to the Committee on Occupational Classification and Analysis is to review the need for continuing the occupational analysis program of the U.S. Employment Service and its principal product, the *Dictionary of Occupational Titles*. The committee was asked to consider in executing this charge both the requirements of Employment Service operations and those of other users, public and private, for the kind of information provided. The preceding chapters have presented the evidence on which we base our conclusions and recommendations.

CONCLUSIONS

In terms of the charge, our conclusions are the following:

1. *There is a strong and continuing need both within and outside the U.S. Employment Service for the kind of information provided by the* Dictionary of Occupational Titles *and certain other products based on it.*

2. *Substantial improvements in the procedures and products of the occupational analysis program are required in order to meet the national need for occupational information.*

Conclusion 1, the continuing need for a document that provides occupational information, takes into account three functions of the DOT: as a dictionary, as a classification system, and as a source of material on occupational characteristics.

DICTIONARY

The DOT is first and foremost a dictionary, which defines more than 12,000 occupations through descriptions of their work content and cross-references an additional 16,000 occupational titles to these 12,000 defined occupations. As such it provides a common understanding as to what is meant when a particular occupational title is used; it is by far the most comprehensive source of occupational definitions available in the United States.

This aspect of the DOT is of very great importance to a wide variety of users, as chapter 4 details. We believe that there would be almost unanimous agreement that such a document, providing a standardized terminology and standardized definitions of that terminology, is essential. Is it, however, specifically essential to the Employment Service's goals—its placement and counseling operation?

We believe that it is. Some proponents of the matching of jobs and applicants by computer have suggested that keywording obviates the necessity for defined titles, since descriptions of a particular job and of a particular worker's attributes can be entered directly into the computer matching system without the intervening mechanism of a title. Such a conclusion seems to us unrealistic because it fails to recognize the role that the occupational title plays in everyday language and in the labor market. The occupational title is shorthand (or, perhaps better, "short talk"). An employer placing a job order for a Computer Programmer does not expect to describe what a programmer does but only the particular requirements, within the general category of programmer, for a particular job. An applicant with experience as a Lumber Scaler is certainly better served if the placement interviewer knows or can find in the dictionary what a lumber scaler does, because local terminology may vary and because the interviewer may then be able to suggest other occupations that make use of similar skills.

For this reason, then, a document that defines terms is essential to the Employment Service's operation; some mechanism for constantly revising such a document must be maintained as new terminology comes into use and new activities arise.

CLASSIFICATION

The basic purpose of the classification structure of the DOT is to organize occupational titles and definitions in an order that facilitates the matching of job applicants and jobs, by grouping together jobs and occupations that are relatively interchangeable in terms of the requirements they make of a worker. In the terminology of the occupational analysis program an individual worker holds a position; the set of positions in which workers perform essentially the same activities within a particular establishment is called a job; and the set of jobs in which similar activities are performed across a number of establishments is called an occupation. Jobs are known by many names, and hence a procedure is needed to group together similar jobs with different titles. The 12,099 occupations defined in the fourth edition DOT constitute a classification of a much larger number of jobs—those held by some 100 million workers in the American labor force.

If all job applicants knew exactly what jobs they were qualified and willing to perform, the classification structure of the DOT could be restricted to grouping job titles into occupational categories. However, many workers are in fact able to do different kinds of work. To optimize their employment opportunities, a classification structure is needed that links together all the occupations in which a worker with particular skills and qualifications might reasonably be employed. To serve as an effective job placement tool then, the DOT must be organized in such a way. In addition, the DOT classification should also be compatible with other widely used classifications to facilitate the reporting and comparison of occupational statistics.

OCCUPATIONAL CHARACTERISTICS

Closely related to the classification system are the attributes of occupations and of workers that the Employment Service calls worker functions and worker traits. These attributes provide information on such items as training time, working conditions, physical effort, etc. As chapters 3 and 4 detail, this information is used for many purposes, including vocational guidance, job placement, rehabilitation counseling, and the determination of program eligibility for training funds. Moreover, it is clear that the worker functions and worker traits would be even more widely used if these data were more readily available and if additional characteristics were measured.

In sum, the DOT serves as the major source of occupational data currently available and would be sorely missed if it were discontinued. The need for the kind of information that is contained in the DOT is confirmed by the extent of its distribution. Over its 13-year life (1965–1977), 148,145 copies of the third edition DOT were sold by the U.S. Government Printing Office, and in the first 21 months of availability (through September 1979), 115,115 copies of the fourth edition DOT have been sold.

Evidence for conclusion 2—that substantial improvements are needed in the occupational analysis program—is found throughout the report: chapter 4 identifies the kind of occupational information that is needed but not currently available; chapter 5 identifies various organizational difficulties in the program; chapters 6 and 7 evaluate the procedures used to collect the occupational information contained in the DOT as well as its quality; and chapter 8 assesses the classification structure of the DOT from the standpoint of its usefulness in matching workers and jobs. The material presented in these chapters leads the committee to conclude that data collection procedures are deficient in important respects, particularly in the way in which occupations are selected for observation and analysis and in the way in which worker trait and worker function ratings are measured. Furthermore, the current classification structure of the DOT does not appear to be optimal for the purpose of matching jobs and workers, nor does the proposed keyword system appear to be an adequate substitute.

Our conclusions that there is a strong need both to continue and to improve the DOT lead us to 3 general recommendations intended to strengthen the occupational analysis program and to 19 specific recommendations intended to improve the quality of the DOT and, more generally, to facilitate the development of occupational information of high quality.

GENERAL RECOMMENDATIONS

1. *The occupational analysis program should concentrate its efforts on the fundamental activity of job analysis and on research and development strategies—for improving procedures, monitoring changes in job content, and identifying new occupations—that are associated with the production and continuous updating of the* Dictionary of Occupational Titles. *The program should discontinue the publication of career guides.*

In the judgment of the committee, too much of the energy and resources of occupational analysis staff, both in the national office and the field centers, has been diverted from the central mission of the occupational analysis program: the production of the *Dictionary of Occupational Titles* (see chapter 5). Primary attention should be devoted to research designed to improve the quality of occupational data, the management and execution of the very complex data collection effort, and the preparation of supplements to and new editions of the DOT. Other appropriate tasks—insofar as they do not distract from the main task—include the preparation of special reports for other agencies based on DOT data and training and technical assistance on the use of the DOT.

The production of career guides and brochures should not be continued as a function of the occupational analysis program. Such activities should be the responsibility of other agencies currently engaged in this type of information dissemination. At the national level the products of the occupational outlook program of the Bureau of Labor Statistics are widely used; at the state and local level the recently organized career information services program, with its links to vocational education and other relevant state systems, provides information to state residents on employment opportunities available in their own localities. Both organizations are dependent on data gathered by the occupational analysis program, and strong communication channels among these agencies are essential. The division of labor between data gatherers and those charged with disseminating information to the public is a rational one, however, which will lead to better use of the quite different specialized skills called for in each of these responsibilities.

Similarly, the Job Search Branch of the Division of Occupational Analysis should be relocated. The Job Search Branch is an effective unit, but it relies on information furnished by local Employment Service offices and has no particular connection to the major activities of the occupational analysis program. Moreover, its presence in the Division of Occupational Analysis may distract resources from the occupational analysis activities that should be the primary concern of the division.

2. *A permanent, professional research unit of high quality should be established to conduct technical studies designed to improve the quality of the* Dictionary of Occupational Titles *as well as basic research designed to improve understanding of the organization of work in the United States.*

A number of the recommendations below relate to research needed in specific areas in order to strengthen the occupational analysis program. In our judgment, however, the gravest difficulty lies not in specific areas but in the general lack of a research orientation. The early editions of the *Dictionary of Occupational Titles* were at the forefront of the occupational analysis of their time. For later editions this is no longer true: the program has been allowed to stagnate. It will not become a vital force again unless the importance of quality research, well integrated into the academic disciplines providing the basic foundations for occupational analysis, is recognized.[1]

While the committee is not prepared to make detailed recommendations regarding the location of a research unit[2] or the exact size of its staff, we have firm opinions regarding the considerations that should be kept in mind in developing such a unit. First, we envision a unit with a relatively large, high-level staff, of the order of 10 Ph.D.-level scientists (sociologists, economists, psychologists, and statisticians), perhaps an equal number of B.A.- or M.A.-level research assistants, and a sufficient number of support staff. We thus envision a research unit that is larger than the current Occupational Analysis Branch in the national office of the Division of Occupational Analysis. We recognize that this is a period of budgetary restraint, but we would be derelict in our responsibiity if we did not express our strong conviction regarding what is needed for a viable federal occupational analysis program simply because of current (and perhaps short-run) budgetary limitations.

3. *An outside advisory committee to the occupational analysis program should be established. Its members should be appointed by the Assistant Secretary of Labor for Employment and Training.*

This outside advisory committee should include representatives of employers and of unions familiar with the problems of occupational classification and placement, persons from relevant academic disciplines, and members of the public. It should meet periodically, perhaps twice a year, to receive and review reports on the work of the occupational analysis program and to make recommendations on future activities.[3]

Four considerations underlie this recommendation:

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[1] A good example of a successful research capability within an operating agency is to be found in the Bureau of the Census. High-quality technical studies are produced by the Census Bureau on a continuing basis; staff regard themselves as professional social scientists and statisticians, have close ties with their academic disciplines, regularly attend professional meetings, and are frequently drawn from or move to academic positions.

[2] The committee spent some time discussing alternative organizational arrangements, ranging from the establishment of a new unit within the Division of Occupational Analysis to the creation of an entirely independent occupational research institute within the federal government but outside the Department of Labor. In the end, however, we decided that we did not have the necessary organizational knowledge to advise on the optimal mechanism for creating an occupational research capability, although we are firm in our judgment as to its necessity.

[3] Again, the Census Bureau provides a good example. The Advisory Committee on Population Statistics, which meets twice a year, plays an active role in recommending and reviewing procedures. Its members are drawn from representatives from the Population Association of America and other interested groups.

We believe that the periodic reporting to an informed outside advisory committee would have a salutary effect on the planning and organizational efficiency of the national office of the Division of Occupational Analysis or any successor unit.

Such an advisory committee would help to prevent the research that is essential to the program from becoming swamped by the exigencies of operational considerations in an agency (the U.S. Employment Service) whose primary focus is operational. It is our impression that the needs of the occupational analysis program for adequate staff, in particular in the national office, have not received sufficient attention in the past. An outside advisory committee would strengthen the position of the program by providing it with a constituency.

In our view, the occupational analysis program has not been successful in communicating its goals or its problems to those groups standing to benefit most from its activities. A public advisory committee would provide some liaison to these groups and help to enlist their cooperation.

Finally, all organizations, inside or outside the government, tend inevitably to develop procedures that acquire a sacrosanct status unless they are moderated by outside influences. An outside advisory group could raise questions that force the staff to consider the usefulness of established procedures.

SPECIFIC RECOMMENDATIONS

The remainder of this chapter presents a set of recommendations suggesting ways to improve the *Dictionary of Occupational Titles* and, more generally, to facilitate the development of high-quality occupational information. Recommendations 4–8 concern data collection procedures; recommendations 9 and 10 concern the worker function and worker trait scales; recommendations 11–13 concern the classification structure of the DOT and the keyword system; recommendations 14 and 15 propose needed areas of research; and recommendations 16–22 deal with various organizational and administrative issues.

DATA COLLECTION PROCEDURES

4. *On-site observation of job performance by trained occupational analysts, including interviews with workers and supervisors, should continue as a major mode of data collection; experimentation with other data collection procedures, however, should also be undertaken.*

In the judgment of the committee a major strength of the DOT is that the descriptions it contains are based on the analysis of specific jobs rather than on abstract descriptions of occupational categories. We encourage the continuation of this mode of data collection.

A number of considerations have led us to this recommendation. Chief among them is the need for standardization—in the identification of significant tasks, the use of terminology, and the writing of descriptions. Standardization of procedures requires the services of analysts trained to observe in a larger context than an individual firm. As an increasing proportion of jobs are found in the service sector, where variations in activities are less constrained by the requirements of the machinery and equipment that dominate the production sector, the need for standardization will probably become even greater.

We find additional support for our position in the requests of private firms and governmental units (cited in chapter 5) for assistance from field centers and national office analysts in developing classification systems for their employees.

It may in some cases be possible, however, to collect equally useful data via a written instrument—a questionnaire, checklist, or task inventory. Attention should be devoted to developing a repertoire of data collection techniques by exploring the conditions under which each is most effective and using the optimal technique for each situation.

5. *Staffing schedules for establishments in which job analyses are performed should continue to be collected and should be used for research purposes. The recently discontinued tabulation by sex of the number of workers in each occupation should be reinstated.*

Staffing schedules, which outline the distribution of jobs within establishments, are currently used only to identify activities unique to an industry or establishment. In our judgment, however, they have value for at least three other purposes that would substantially improve the occupational analysis program. First, staffing schedules could be used as a check on the representativeness of establishments selected for job analysis by comparing staffing schedule data with the occupational structure of industries revealed through other sources (for example, the decennial census and the occupational employment survey of the Bureau of Labor Statistics). Second, they provide a tool that if properly used could alert occupational analysts to significant changes in occupational structure that may indicate concomitant changes in work content. Third, staffing schedule data are a potentially rich source of information on the differences in occupational opportunities for men and women. Recently, however (in November

1978), the occupational distribution of workers on the staffing schedule ceased to be tabulated separately by sex. In our judgment this change is unfortunate, since it destroys the usefulness of staffing schedule data for an extremely important research purpose. We urge that separate tabulations by sex be reinstated.

6. *The selection of establishments and work activities for which job analyses are performed should be made according to a general sampling plan designed for the particular requirements of occupational analysis.*

The committee recognizes that the variation in the number of job analyses per defined occupation documented in chapter 7 is not *prima facie* evidence of maldistribution of effort. Some occupations are clearly homogeneous in work content regardless of their geographical or industrial setting, whereas the homogeneity or heterogeneity of other occupations can be determined only by comparative job analyses.

We can find no evidence, however, of the use of systematic procedures in the selection of sites, in the selection of jobs to be analyzed, or even in the designation of industries to be included. The task of the national office is to assign industries to field centers according to geographic concentration or, for those industries that are widely dispersed, to obtain geographic representation. The task of the field center, once an industry has been assigned, is to select establishments that represent different size units (in terms of aggregate employment levels) and/or known technological variations. As chapter 7 shows, both goals are very generally stated, and no clear procedures are established for attaining them.

An example of this lack of clarity in the procedures followed is the assignment of industries to field centers by the national office. Industry assignments vary widely in scope: an assignment may be as wide as "retail trade," a category covering establishments engaged in diverse activities, or as narrow as "button," covering establishments engaged in "manufacturing buttons, parts of buttons, button blanks, etc." Neither the basis for the national office's decision to make an assignment broad or narrow nor the procedure by which a field center decides among the possibilities in an industry of broad scope is clear.

The procedures involved in the selection of jobs for analysis are also unclear. The identification of the types of organizations that have unique types of jobs should be an important goal, but current practice appears to be founded on the premise that an establishment's product is a major distinguishing characteristic of its jobs, a premise that reflects the long-standing emphasis of the DOT on manufacturing jobs and their close association with specialized equipment. One consequence of this emphasis is that jobs outside the production sector are generally assumed to require fewer job analyses than those concerned with fabrication. Job analysis is therefore often not undertaken throughout an establishment but is confined to those jobs assumed to be unique to it. Although this limitation is not unreasonable, it may result in the self-perpetuation of an assumption that is no longer accurate. The fine line between unnecessary duplication of job analyses and unsupported assumptions of homogeneity is not easy to draw, but the resolution of this problem must receive attention as the economy shifts increasingly from production to service activities.

In our judgment the set of procedures involved in the selection of jobs for analysis should be thoroughly overhauled so that data can be collected that are truly representative of work content. The Employment Service should seek technical assistance in designing procedures that are both consistent with its needs and statistically sound. (This is a logical function for an occupational research unit, perhaps with the participation of outside consultants.)

7. *Procedures should be designed to monitor changes in the job content of the economy. Both new occupations and changes in existing occupations should be identified.*

As we have noted in chapters 6 and 7, the fourth edition DOT appears to provide better coverage of occupations in traditional sectors of the labor market than in rapidly expanding sectors. We suspect that this is due to the way jobs are selected for analysis. To correct this tendency, we believe that procedures should be developed to monitor explicitly changes in job content in the economy.

We consider first the problem of identifying new occupations. There are several ways this might be done. A range of sources could be continuously or periodically monitored to identify occupational titles not already included in the DOT. Potential sources include the occupational employment surveys of the Bureau of Labor Statistics, job orders received by local Employment Service offices (indeed, such job orders are already a major source in the form of occupational code requests), classified ads in major newspapers, and the *Current Population Survey* (CPS) conducted monthly for the Bureau of Labor Statistics by the Bureau of the Census. Because of its rich potential we urge exploration of ways to use the CPS to monitor the emergence of new occupations. It should be noted that three past CPS samples have been assigned DOT codes by occupational analysts at the field centers (those from April 1967, April 1971, and March 1978—the last still in preparation). Preliminary experimentation could be undertaken using these surveys.

Second is the problem of how to identify changes in the content of existing occupations. This is more difficult, since there is no good way to know in advance of analysis whether the content of an occupation has substantially changed. It may be possible, however, to develop an information network using industrial, trade, and professional associations, labor unions, etc. to keep abreast of rapidly changing occupations. Moreover, it is likely that in those sectors of the occupational structure in which many new occupational titles are emerging there is also rapid change in the content of existing occupations. The national office should develop a monitoring system for identifying sectors of the occupational structure in which there is rapid change, in order to target the occupations in such sectors for intensive analysis.

8. *The* Dictionary of Occupational Titles *should be expanded to include definitions of all occupations in the economy, whether or not they are serviced by the Employment Service.*

As chapter 4 documents, the DOT is widely used outside the Employment Service because it is the most comprehensive source of occupational information available anywhere. As such it should attempt to be complete in its coverage of the occupations practiced in the United States today. The fact is, however, that it is very uneven, covering some occupations in great detail and others not at all.

Several sources can be used to identify occupations not currently included in the DOT: the *Current Population Survey* described above, the Census Bureau's *Alphabetical Index of Occupations and Industries,* classifications of military occupational specialties, the federal government's occupational coding schemes, and various specialized occupational glossaries. These lists should be compared with the list of occupational titles in the DOT. Any title found in another list but not in the DOT would then become a candidate for an intensive job analysis. Procedures should be designed to locate suitable jobs for analysis once they are identified.

MEASUREMENT OF OCCUPATIONAL CHARACTERISTICS

9. *The worker trait and worker function scales should be reviewed and, where it is appropriate, replaced with carefully developed multiple-item scales that measure conceptually central aspects of occupational content.*

The committee has found substantial reason to question the adequacy of the worker trait and worker function scales. First, they do not appear in the aggregate to adequately reflect conceptually central aspects of occupational content. They omit, for example, measures of such important features as the organizational setting in which jobs occur and the degree of responsibility entailed in jobs for decisions, materials, or supervision.[4] At the same time they include measures of interests, aptitudes, and temperaments, which are better thought of as worker characteristics than as attributes of jobs.

Second, the existing scales have not been developed or validated in accordance with current psychometric standards for scale construction, and some of them have been shown (see chapter 7 and Appendix E) to have rather low reliability. Moreover, they are very redundant. In chapter 7 we show that most of the variation among occupations can be described by three factors, and almost all the remaining variation by an additional three factors.

Third, many of the scales have limited use, as chapters 3 and 4 document. In part, this is the result of the way they are published. Although scores on the worker function scales (DATA, PEOPLE, and THINGS) are available for each DOT occupation—because they are included as part of the occupational classification code—scores on worker trait scales for each occupation in the third edition DOT are available only in supplements. Ranges of scale scores are also published for groups of occupations in volume 2 of the third edition DOT. Scores on the worker traits scales for the fourth edition had not been published as of January 1980, although they are available on computer tape.[5]

The development of a new set of scales of occupational characteristics is a research activity that should be undertaken prior to the publication of the next edition of the DOT and then continued as an ongoing activity of the research unit. The first step is to determine what occupational information is needed by major users of the DOT, including the Employment Service. Suitable scales to elicit this information should then be developed—and validated—using standard psychometric procedures.

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[4] Responsibility and supervision are highly relevant for job placement and for other purposes as well, including the analysis of career ladders (identified by many respondents to the user survey as highly desirable information to add to the DOT) and equal employment opportunity issues.

[5] A tape containing all of the worker traits for the fourth edition (known as the DOT master tape) may be obtained from the National Technical Information Service (Document No. PB 298 315/AS).

10. *A research activity of first priority should be review of the training time (GED and SVP), physical demand, and working condition scales.*

Our review of DOT uses indicates that the training time, physical demand, and working condition scales are used widely for making key determinations in a variety of employment-related programs by government and other agencies. In some instances the worker function (DATA, PEOPLE, and THINGS) scales are inappropriately used as substitutes for training time scales. This may occur because of lack of knowledge of the worker trait scales, since worker functions are included in the basic occupational code, while worker traits are treated as separate dimensions and, in the third edition DOT, were published in supplementary volumes.

We believe the need for and interest in these occupational characteristics are sufficient to warrant continuous effort and special publication by the occupational analysis program.

CLASSIFICATION ISSUES

11. *A major activity of the occupational analysis program should be investigation of cross-occupational linkages that indicate possible transferability of skills or experience.*

Hitherto, the occupational analysis program has done comparative job analysis only to the extent necessary to fit jobs into occupational units within the established classification. The implicit assumption with respect to matching workers and jobs has been that the classification structure itself will reveal the range of possible matches.

In our judgment this is too narrow a use of the occupational analyst's skills and too rigid a conception of what constitutes "similar" work. An informed glance through the detailed occupational classification of the DOT reveals a number of instances in which similar work performed in different work settings results in two codes that differ at the most aggregated, one-digit level. This experience can probably be repeated with any classification system yet devised.

A number of procedures to aid in identifying occupations for which the required tasks are sufficiently alike to permit transfer of skills could be proposed. Two that appear to have special promise are (1) the comparative analysis of skill requirements via task analysis or other structured job analysis procedures and (2) the empirical identification of "interchangeable" occupations via the analysis of rates of naturally occurring occupational mobility. The basic idea in the latter proposal is that if people who leave a particular occupation are especially likely to take up certain other occupations, then those occupations are probably similar in their requirements, and hence job applicants with experience at one occupation could work at the others.

Job history data are currently collected routinely from job applicants by local Employment Service offices. These data could be used to estimate rates of movement between occupational categories that are specific to local labor markets, and the validity of the suggested interchangeability could be reviewed by trained analysts. If valid linkages emerged, those occupations with high interchangeability rates could be listed together in job banks, could be matched in the keyword or other automated systems, and could be listed for the use of job placement interviewers. It is important to note that classifications for placement purposes need not list each occupation only once. For example, a job opening could be included at several different places within a job bank to facilitate the job search process, in much the same way that books are cross-referenced in a library catalogue. We urge full exploration of these possibilities.

12. *The development of an automated procedure for matching job applicants with job openings should continue, but the current keyword system should not be accepted as optimal.*

Appendix G presents an evaluation of the keyword system, the most widely used method of computerized job matching attempted by the Employment Service. The conclusions in Appendix G support the findings of critics who have called the system inadequate and inadequately tested prior to its implementation.

We wish to emphasize, however, the need for continued research and experimentation in the use of automated data processing in both the job analysis and placement operation of the Employment Service. The exploratory work done by our staff (presented in Appendixes G and H) is suggestive of the potential inherent in this tool for assessing and developing classifications. Time and resources have limited the extent to which this exploration could be undertaken, but we are convinced of its long-term value.

Experimental work in computerized job matching should continue in tandem with the development of an improved classification. In this the experience gained from the keywording operation should be carefully evaluated. For example, the "complementary terms" concept used in keywording may present an alternative to the very detailed and probably overly inflexible coding system now used in the DOT. A simplified set of occupations associated with a range of complementary terms may serve the purposes of placement better than either the nine-digit DOT code or the occupational unit framework of the keyword system. In urging additional experimental work, we wish to caution against the precipitous, large-scale implementation of poorly or incompletely tested schemes. The optimal strategy would be to conduct a series of small-scale studies before adopting any particular scheme.

13. *The classification system developed for the next edition of the DOT should be compatible with the standard system implemented by the Office of Federal Statistical Policy and Standards or its successor coordinating federal agency. That is, explicit procedures should be developed to enable the translation of occupational codes so that information can be organized and reported using a standardized classification.*

The relationship between the classification system used by the Employment Service, embodied in the DOT, and that used by other governmental agencies is a crucial issue. The committee believes that arguments for a standardized classification for reporting occupational data are so compelling as to leave no doubt of the importance of this goal. Within the context of this report, the need for the Employment Service's operating statistics to be part of a standardized system is clear. Therefore an essential task is to ensure that occupational information generated by the Employment Service can be translated to allow reporting in terms of a standardized occupational classification.

Congress has established a National Occupational Information Coordinating Committee (Public Law 94-482; October 12, 1976), which has as one of its responsibilities the development and implementation of an occupational information system " . . . which system shall include data on occupational demand and supply based on uniform definitions, standardized estimating procedures, and standardized occupational classifications. . . . " Beyond this legislative requirement the committee believes that an understanding of the Employment Service's role in the labor market is essential to its proper functioning and that for such an understanding, Employment Service operating statistics must be related to aggregate data for the labor force. Without a standardized classification system this connection is impossible to make.

We believe that the occupational analysis program should take a lead role in providing the material and expertise required to keep the *Standard Occupational Classification* (SOC) up to date—a role that is compatible with its activity in developing the SOC.

OTHER NEEDED RESEARCH

14. *Research priority should be given to developing criteria for defining "occupations"—the aggregation problem.*

What is an occupation? It is a set of jobs that are similar in some way, in terms of tasks, duties, responsibilities, organizational or industrial setting, status, etc. Occupational classifications group occupations in terms of their similarity according to one or several of these criteria or still others. Classifications differ in two ways: first, in terms of the criteria of similarity, the grouping principle; and second, in terms of the level of aggregation, the number of distinctions that are made between elements, or occupations, in the classification. The 1970 Census classification, for example, contains 441 occupations, while the fourth edition DOT contains 12,099 occupations. Obviously, the census occupations on the whole encompass a more heterogeneous set of jobs than do the DOT occupations. Despite the greater specificity of DOT occupations, however, there appears to be great variation from one occupation to another in their degree of heterogeneity. For example, there are 70 kinds of Sewing Machine Operator, Garment, with the same 6-digit code (786.682), while there are 6 kinds of Secretary with the same 6-digit code (201.362). Moreover, inspection of the occupational definitions suggests more variability among the 6 secretarial occupations than among the 70 kinds of sewing occupations. There appears to be no conceptual basis for delineating boundary lines between occupations.

Research is needed both on the conceptual basis for defining occupations and on the consistency with which occupational boundaries are drawn in the fourth edition DOT, to provide a basis for revisions in the fifth edition. In undertaking a review of the existing occupational categories in the fourth edition DOT, attention should be paid to the possibiity that certain categories of occupations (e.g., clerical or service occupations) are insufficiently differentiated, or that certain categories (e.g., benchwork occupations) are overly differentiated. We urge exploration of strategies for reviewing the consistency of specificity of DOT occupations.

15. *Basic research should be undertaken on the operation of labor markets to improve understanding of the processes by which workers acquire jobs.*

The Employment Service could do a great deal to improve its ability to place workers in jobs through research on the processes by which workers acquire jobs. In chapter 8 we proposed an empirical procedure for defining interchangeable clusters of jobs on the basis of occupational mobility rates. The usefulness of such a procedure would be even greater with a better understanding of occupational mobility processes in general. What kinds of jobs tend to be open to workers with particular sorts of experience? Which jobs are filled by those who have previously worked elsewhere, which are filled by those just entering the labor force, and which are filled only by promotion from within an establishment? To what extent do sex, age, or race continue to be barriers to occupational opportunities, and are such barriers concentrated in particular sectors of the labor force? This research is likely to be most fruitful if it builds on institutional and segmented market approaches to labor market analysis, since these approaches focus on the very job and market structures that are at issue here.

The Employment Service, in particular the occupational analysis program, is in a unique position to conduct research on such questions. Job history data currently collected routinely in the course of job placement interviews and establishment studies currently conducted on a regular basis for the purpose of job analysis are valuable sources of data that should be exploited in the interest of improving the ability to match workers and jobs.

These data sources should also be exploited to improve understanding of career progressions, typical patterns of movement from job to job. When respondents to the survey of DOT users were asked how future editions could be improved to meet their needs better, the inclusion of career ladders was most often mentioned; the majority indicated that they would find such information helpful. While there undoubtedly is substantial variability in career progressions, some indication of typical sequences of jobs would be very useful for counseling purposes. Two existing data sources could be used to produce such information. First, the job analysis schedules used by occupational analysts include information on the relation of the job being analyzed to other jobs—specifically, promotion lines, transfer lines, and lines of supervision. This information could be used to describe typical career ladders within enterprises. Second, the work history data collected routinely from job applicants in local employment service offices could be used to describe typical career ladders involving mobility among enterprises, in the manner discussed in chapter 8. We urge that these possibilities be explored.

ORGANIZATIONAL AND ADMINISTRATIVE ISSUES

16. *The leadership of the national office in the occupational analysis program should be strengthened; greater attention should be given to coordination of field center activities; and the lines of federal authority should be clearly established.*

In view of the intensive management study (Booz, Allen & Hamilton, Inc., 1979) commissioned by the Department of Labor in tandem with its request to the National Academy of Sciences for a study of long-range needs, the committee has concerned itself only with those aspects of organization that are directly related to the substantive content of the occupational analysis program.

In this context we strongly endorse the Booz, Allen & Hamilton conclusion that strong leadership and increased coordination by the national office are essential. Throughout our report (notably in chapters 5 and 6) are specific instances of the costs that lack of leadership by the national office have produced in terms of quality. We particularly support the follow-up recommendation of the Office of Technical Support (U.S. Department of Labor, 1979b) that a written agreement between the Employment and Training Administration and the host state of each occupational analysis field center lay out clearly the rights and prerogatives of the federal government in the control of field center activities.

The committee is not persuaded, however, that the Booz, Allen & Hamilton recommendation that the number of field centers be halved is, in the long run, a wise one. Although in the short run such a reduction may be a useful way to eliminate those field centers whose contribution to the program has, for a variety of reasons, been below the desirable level, in the long run, geographical dispersion seems to us to be a strength, particularly in view of the new trends in population dispersion currently taking place in the United States. The problems of coordination by the national office may be reduced by a reduction in the number of field centers, but the problems of communication between the occupational analysis program and local office operating staff will certainly be increased.

17. *The collection and dissemination of occupational information by the occupational analysis program should be a continuous process; activity should not fluctuate with the timing of new editions of the DOT.*

This recommendation follows from recommendation 1—that the program should concentrate its effort on job analysis. Chapters 6 and 7 present evidence of the costs, in terms of thoroughness and quality, of gearing the program so closely to the publication of the new edition. Beyond this, however, we believe that to be most useful to the Employment Service's operating offices and to other users, occupational information should be kept current by closely monitoring the introduction of new jobs and changes in the content of existing jobs.

18. *Procedures followed in collecting data and developing the DOT should be carefully documented and publicly described.*

The committee found that many procedural decisions appear to be made on an *ad hoc* basis and to be poorly documented. The lack of documentation, experimentation, and research on the efficacy of the procedures used seems to the committee to be one of the most serious deficiencies in the occupational analysis program. Although we recognize that the Employment Service is an operating agency whose purpose is to deliver service, such a service cannot be delivered for the highly complex and continuously changing world with which the Employment Service deals on the basis of *ad hoc* decisions that are never documented or systematically communicated to persons in operational roles. The lack of documentation makes the review and evaluation of Employment Service occupational information difficult for users, who should be supplied with this essential information.

19. *The data produced for the DOT should be made publicly available.*

As well as being underdocumented, the DOT is underpublished, in the sense that a great deal of material of great value to researchers is not made easily available. Public-use computer tapes and attendant documentation should be created for each of the data sets used in the preparation of new editions of the DOT and deposited in data archives such as the National Technical Information Service and the Inter-University Consortium for Political and Social Research at the University of Michigan. For example, the third-to-fourth edition map, and the 1966 and 1971 CPS tapes coded with DOT codes (and the March 1978 CPS tape when it becomes available) should all be made publicly available.[6] Public access to data used in preparing the DOT can do nothing but improve the quality of the DOT.

[6] The DOT master tape containing all of the worker trait codes for the fourth edition is already available (see note 5). In addition, the committee deposited two magnetic tapes with the National Technical Information Service and the Inter-University Consortium for Political and Social Research: (1) the April 1971 *Current Population Survey* ($N = 60{,}441$), which includes third and fourth edition DOT codes, and (2) a summary tape of DOT occupational characteristics, which was created from the 1971 CPS and provides average DOT scores and factor-based scale scores for the expanded ($N = 574$) 1970 Census occupational classification (for details, see Appendix F).

Second, for the benefit of users without ready access to computers, data on the characteristics of each occupation (currently the worker traits and worker functions) should be published, with exact scores for each DOT occupation.

20. *A tabulation program should be instituted immediately to aggregate monthly data from Employment Service operations to the revised* Standard Occupational Classification *unit groups used in the 1980 Census of Population and subsequent current population surveys.*

The current version of the *Standard Occupational Classification* has attempted to provide an interim solution to the problem of compatibility by allocating each of the 12,099 nine-digit codes of the fourth edition DOT to one of the approximately 600 four-digit unit groups of the SOC. A similar crossover listing between the classifications, to be used in the 1980 Census of Population and the SOC unit groups, has been developed by the Bureau of the Census. It therefore becomes possible, if computerized operating statistics are available at a nine-digit level, to rearrange these data into the census classification (or any other classification system providing such a crossover listing).

Both recommendation 20 and recommendation 13 are closely related to the congressional instruction to the secretary of labor to institute a uniform reporting program, under the Comprehensive Employment and Training Act, using a detailed occupational or training code, a term defined as "any occupational or training code equivalent in detail to the *Standard Occupational Classification* at the four-digit level" (Public Law 95-524; October 27, 1978; Section 313 (g)(31)).

21. *A systematic program should be instituted to communicate additions and revisions of occupational definitions and their classification promptly to all operating staff in the Employment Service as well as to other interested persons.*

It is crucial to the successful operation of the Employment Service and to other major users of the DOT as well that the occupational information provided by the DOT be up to date. It is in those sectors of the occupational structure that are most rapidly changing that the need for information is greatest. For this reason it is insufficient to rely on the periodic publication of new editions of the DOT. A mechanism should be established to transmit information continuously on new and changing occupations and on newly established linkages between occupations to all concerned persons. What we have in mind is a monthly news bulletin, issued by the occupational analysis program and circulated to all Employment Service personnel and to other interested parties, and an annual supplement to the DOT incorporating all such information produced in the preceding year.

22. *The next edition of the DOT should not be issued until substantial improvements in the occupational analysis program have been made, following the recommendations made here.*

There is no need to rush to a fifth edition of the DOT, especially if a program of continuous updating and dissemination of occupational information is developed as proposed above. Such a program would serve the needs of users for up-to-date occupational information by keeping the fourth edition current. This would permit time for a fifth edition to be fundamentally redesigned on the basis of the research proposed here—on the classification structure, the measurement of occupational characteristics, the definition of occupations, data collection procedures, and so on. We would expect such research to continue indefinitely and to serve as the basis for further modifications of subsequent editions of the DOT. Hence we are not proposing delay until completion of a single massive research effort, but rather delay until a permanent, ongoing research effort has been well begun and has borne fruit.

APPENDIXES

APPENDIX

A Materials Associated with the User Survey

Appendix A contains responses to a questionnaire that the committee used to survey DOT users. As the accompanying letters show, two kinds of users were surveyed: the first letter was sent to a sample of single-order purchasers of the DOT, and the second letter was sent to DOT users in state agencies.

The purchasers of the DOT were randomly sampled from a list of names and addresses, provided by the U.S. Government Printing Office, of individuals who purchased the fourth edition DOT during its first six months of availability. The state users are a casual sample of individuals identified by staff of the State Occupational Information Coordinating Committee (SOICC) as users of the DOT.

The questionnaire was part of the committee's effort to determine the nature and extent of the uses made of the DOT outside the Employment Service. Other sources of information were site visits to federal agencies identified as major users (see Appendix B) and a literature review of social science research uses of the DOT (see Appendix C).

Chapter 4 contains more detail about the sampling design and timing as well as a detailed analysis of the responses.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES
2101 Constitution Avenue Washington, D. C. 20418

COMMITTEE ON OCCUPATIONAL
CLASSIFICATION AND ANALYSIS

April 13, 1979

Dear Sir or Madam:

We are assessing the present use of and future need for the *Dictionary of Occupational Titles* (DOT) and other publications of the Department of Labor's Occupational Analysis program. In order to make informed judgments, we are collecting relevant information from users of these publications. Therefore, we would greatly appreciate your assistance in completing the enclosed questionnaire, which is being sent to a sample of those who have purchased the *Dictionary of Occupational Titles* in the past year. *If you ordered these occupational materials for a person or group other than yourself, please pass on this questionnaire to the appropriate individual.*

Your participation in this survey is completely voluntary. All the information you give will be protected under the Privacy Act of 1974. This means that your answers will be kept strictly confidential. Results of the study will be made public only in summary or statistical form so that individuals who participate cannot be identified.

We also welcome any other information you might wish to provide on your use and/or evaluation of the *Dictionary of Occupational Titles* and other Occupational Analysis publications. If you have any questions concerning this inquiry, please call Patricia Roos collect (202-389-6345). We would appreciate it if you would complete and return the enclosed questionnaire within the coming week. Thank you for your cooperation.

Sincerely,

DONALD J. TREIMAN
Study Director

Enclosure

OMB No. 44S-79006
Approval Expires 12/31/79

DOT PURCHASERS (N = 309)

SURVEY OF PURCHASERS OF THE *DICTIONARY OF OCCUPATIONAL TITLES* CONDUCTED BY THE NATIONAL RESEARCH COUNCIL

The accompanying letter requests your assistance in this survey of recent purchasers of the *Dictionary of Occupational Titles*. **Please read the instructions** carefully and answer by printing your reply or entering a "✓" in the appropriate box. **Please return** the completed form in the enclosed postage-paid envelope to the Committee on Occupational Classification and Analysis, National Academy of Sciences, JH820, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

NOTE: All information you provide will be treated as confidential and used for statistical purposes only.

1702 (1-4)

1 ___ (5-8)

1. Sex: 62% 1 ☐ Male 35% 2 ☐ Female 4% NA (11/9)

2. Please indicate the type of employer for whom you work (please be as specific as possible) (12-13/99)

13% 1 ☐ Library
21% 2 ☐ High School, Jr. High
5% 3 ☐ Technical, Vocational, or Trade School
16% 4 ☐ College or University
6% 5 ☐ Federal Government
* 6 ☐ State Government-Employment Service
6% 7 ☐ State Government (other)

6% 8 ☐ County/Local Government
0% 9 ☐ Labor Union
10% 10 ☐ Other private non-profit organization/community group (please specify): ______
2% 11 ☐ Private, profit-making business employing less than 100 workers

4% 12 ☐ Private, profit-making business employing between 100 and 499 workers
7% 13 ☐ Private, profit-making business employing 500 or more workers
1% 14 ☐ Self-employed
0% 15 ☐ Not presently employed
1% 16 ☐ Other (please specify): ______

3. Please check the category which best characterizes the type of work you do: (14-15/99)

29% 1 ☐ Career or Vocational Counseling
7% 2 ☐ Rehabilitation Counseling
7% 3 ☐ Vocational Education
8% 4 ☐ Job (employment) Placement

9% 5 ☐ Personnel Management
4% 6 ☐ Labor Force Projections (Manpower Planning)
3% 7 ☐ Occupational Information Development and Dissemination
3% 8 ☐ Compensation Administration

4% 9 ☐ Teaching
18% 10 ☐ Librarianship
1% 11 ☐ Research (describe subject area): ______
4% 12 ☐ Other (please specify): ______
3% General Management Admin.
1% NA

4. Please list any professional, scientific, or trade associations, relevant to your main employment, to which you belong.

______ ______ (16-21)
______ ______ ______

5. Have you ever used the *Dictionary of Occupational Titles* in your work?

* 1 ☐ Yes 2 ☐ No (22/9)

If YES, go on to question 6

If NO, go to question 15

* Percentages calculated for non-Employment-Service respondents who use the DOT.

DOT PURCHASERS

Questions 6 through 14 are for users of the *DICTIONARY OF OCCUPATIONAL TITLES*

6. A. *Which of the following volumes of the Dictionary of Occupational Titles have you **ever used?***

B. *How frequently have you used the various Dictionary of Occupational Titles volumes in your work within the **past year?***

A. *Ever used?* (Check all that apply)			B. Frequency of use within the past year: Regularly (1)	Occasionally (2)	Never (3)		NA
13% ☐	First or second edition (1939, 1949)	(23/9)	4% ☐	6% ☐	29% ☐	(29/9)	62%
55% ☐	3rd edition Volume One: "Definitions of Titles" (green hardback, 1965)	(24/9)	19% ☐	30% ☐	13% ☐	(30/9)	37%
65% ☐	3rd edition Volume Two: "Occupational Classification, Industry Index, Worker Traits Arrangements of Titles and Codes" (green hardback, 1965)	(25/9)	17% ☐	29% ☐	15% ☐	(31/9)	40%
35% ☐	3rd edition Supplement One: "Selected Characteristics of Occupations (Physical Demands, Worker Characteristics, and Training Times)" (green paperback or hardback, 1966)	(26/9)	13% ☐	20% ☐	18% ☐	(32/9)	49%
31% ☐	3rd edition Supplement Two: "Selected Characteristics of Occupations by Worker Traits and Physical Strength" (grey paperback, 1968)	(27/9)	10% ☐	18% ☐	20% ☐	(33/9)	51%
88% ☐	4th (present) edition (red paperback, 1977)	(28/9)	43% ☐	45% ☐	5% ☐	(34/9)	7%

7. A. *Which information from the Dictionary of Occupational Titles and supplements have you ever used?* (Check all that apply)

95% ☐	Job Titles and Definitions	(35/9)	38% ☐	Specific Vocational Preparation (SVP) estimates (3rd ed.; vol. 2 or supplement #2)	(40/9)
27% ☐	Industrial Designation Arrangements	(36/9)			
59% ☐	Occupational Codes and/or Classification	(37/9)	38% ☐	Interest, Aptitude, and Temperament information (3rd ed.; vol. 2)	(41/9)
41% ☐	Worker Trait Groups (3rd ed.; vol. 2)	(38/9)			
30% ☐	General Educational Development (GED) estimates (3rd ed.; vol. 2 or supplement #2)	(39/9)	34% ☐	Environmental and Physical Working Conditions information (3rd ed.; vol. 2 or supplement #2)	(42/9)

B. How have you used this information? ______________________ (43-48)

____

______________________ ________

8. Have you ever used the *Dictionary of Occupational Titles'* ratings of the level of worker functioning in relation to Data, People, and Things (the 4th through 6th digits of the *Dictionary of Occupational Titles'* codes)?

36% 1 ☐ Yes 61% 2 ☐ No 3% NA (49/9)

If YES, would you describe for what purpose you use these ratings:

______________________ (50-55)

____

______________________ ________

DOT PURCHASERS

9. Consider the main purpose for which you use the *Dictionary of Occupational Titles*. How adequate is it for this purpose?

61% 1 ☐ Very adequate 35% 2 ☐ Somewhat adequate 3% 3 ☐ Inadequate 4% NA [illegible]

Please detail any inadequacies: ______________________ [illegible]

____

______________________ ________

____

10. How would it affect your work if no further editions of the *Dictionary of Occupational Titles* were produced?

12% 1 ☐ Would not be affected 28% 3 ☐ Would cause major inconvenience [illegible]

50% 2 ☐ Would cause minor inconvenience 7% 4 ☐ Would seriously disrupt work

3% NA

If it would cause inconvenience or disrupt work please elaborate: ______________________ [illegible]

____

______________________ ________

11. If the *Dictionary of Occupational Titles* were unavailable, are there substitute sources to which you could turn for the same information?

37% 1 ☐ Yes 25% 2 ☐ No 37% 8 ☐ Don't know 2% NA (70/9)

If YES, please list or describe them: ______________________ (71-78)

____

______________________ ________

1702 (1-4)

2 (5)

12. Compared with the 4th edition, how could future editions of the *Dictionary of Occupational Titles* be improved to better meet your needs? (please check all with which you agree):

38% ☐ Use of hard cover (11/9)

29% ☐ Division into two or more volumes for greater ease in usage (12/9)

31% ☐ More frequent publication (13/9)

54% ☐ Inclusion of career ladders (14/9)

38% ☐ Inclusion of worker trait ratings of General Educational Development (GED) and Specific Vocational Preparation (SVP) (15/9)

45% ☐ Inclusion of worker trait ratings of interests, aptitudes, and temperaments (16/9)

40% ☐ Inclusion of worker trait ratings on physical demands and working conditions (17/9)

13% ☐ Explicit incorporation of Standard Occupational Classification (SOC) codes (18/9)

10% ☐ Inclusion of additional occupations (please specify): (19/9)

____

____

10% ☐ Other suggested improvements: ______________________ (20/9)

____

____

DOT PURCHASERS

13. What do you regard as the most valuable features or contributions of the *Dictionary of Occupational Titles*? (please check all that apply)

41% ☐	DOT codes	(21/0)
8% ☐	Job titles and definitions	(22/0)
50% ☐	Occupational group arrangement—job families	(23/0)
40% ☐	Worker functions (complexity of relationship to Data, People, or Things)	(24/0)
38% ☐	Worker trait information (GED, SVP, interests, aptitudes, and temperaments, physical demands and working conditions)	(25/0)
4% ☐	Other valuable features or contributions (please specify) __________	(26/0)

14. How would you rate the *Dictionary of Occupational Titles* with respect to the following criteria:

	Very Adequate (1)	Somewhat Adequate (2)	Inadequate (3)	Don't Know (8)		NA
a) Coverage of the types of jobs in which women usually predominate	20% ☐	26% ☐	6% ☐	38% ☐	(27/0)	11%
b) Coverage of the types of jobs in which minorities usually predominate	16% ☐	19% ☐	10% ☐	44% ☐	(28/0)	11%
c) Rating of worker functions and traits for jobs in which women usually predominate	14% ☐	24% ☐	7% ☐	43% ☐	(29/0)	12%
d) Rating of worker functions and traits for jobs in which minorities usually predominate	11% ☐	21% ☐	7% ☐	47% ☐	(30/0)	14%

Please elaborate __________ (31-36)

15. In addition to the *Dictionary of Occupational Titles*, the Occupational Analysis program distributes occupational information in other forms. We are also interested in the frequency with which you may use these brochures or pamphlets. During the **past year**, how frequently have you used the following Occupational Analysis publications in your work?

	Regularly (1)	Occasionally (2)	Never (3)	Not familiar with publication (4)		NA
a) Career Opportunities in the Telephone and Telegraph Industries (1977)	2% ☐	6% ☐	23% ☐	61% ☐	(37/0)	8%
b) Career Opportunities in the Trucking Industry (1978)	4% ☐	8% ☐	24% ☐	58% ☐	(38/0)	7%
c) Handbook for Analyzing Jobs (1972)	4% ☐	11% ☐	18% ☐	57% ☐	(39/0)	10%
d) Health Careers Guidebook (1973)	6% ☐	18% ☐	20% ☐	47% ☐	(40/0)	10%
e) Job Descriptions and Organizational Analysis for Hospitals and Related Health Services (1971)	4% ☐	7% ☐	18% ☐	60% ☐	(41/0)	10%
f) Job Guide for Young Workers (1970)	2% ☐	11% ☐	20% ☐	58% ☐	(42/0)	9%
g) Occupations in Electronic Computing Systems (1972)	2% ☐	7% ☐	20% ☐	60% ☐	(43/0)	11%
h) Occupations in Library Science (1973)	2% ☐	7% ☐	20% ☐	61% ☐	(44/0)	9%
i) Task Analysis Inventories (Series 1) (1973)	1% ☐	6% ☐	20% ☐	63% ☐	(45/0)	10%
j) Job Bank Openings Summary (JBOS; monthly)	5% ☐	12% ☐	15% ☐	56% ☐	(46/0)	11%
k) Frequently Listed Openings (JOB-FLS; monthly)	5% ☐	14% ☐	15% ☐	56% ☐	(47/0)	11%
l) Occupations in Demand (OID; monthly)	12% ☐	16% ☐	14% ☐	48% ☐	(48/0)	9%
m) Labor Market Information Analytical Table Series (LMI-ATS; monthly)	3% ☐	13% ☐	16% ☐	57% ☐	(49/0)	11%

DOT PURCHASERS

16. Below is a list of other occupational information publications, from both government and non-government sources. Please indicate the frequency with which you have used them in your work within the past year.

	Regularly (1)	Occasionally (2)	Never (3)	Not familiar with publication (4)		NA
a) Bureau of Labor Statistics Wage Surveys (e.g., Area Wage Surveys, Municipal Wage Surveys)	20% ☐	37% ☐	16% ☐	18% ☐	(50/0)	8%
b) Occupational Outlook Handbook (Bureau of Labor Statistics)	54% ☐	27% ☐	10% ☐	6% ☐	(51/0)	3%
c) International Standard Classification of Occupations (International Labour Office)	1% ☐	6% ☐	34% ☐	47% ☐	(52/0)	12%
d) Office of Education Classification System (U.S. Department of Health, Education, and Welfare and U.S. Department of Labor)	4% ☐	11% ☐	26% ☐	47% ☐	(53/0)	13%
e) Standard Occupational Classification (U.S. Office of Federal Statistical Policy & Standards)	2% ☐	8% ☐	31% ☐	47% ☐	(54/0)	12%
f) U.S. Bureau of the Census publications (e.g., Occupational Characteristics of the Population, Alphabetical Index of Occupations, Classified Index of Occupations)	7% ☐	26% ☐	24% ☐	31% ☐	(55/0)	11%
g) Handbook of Occupational Keywords (U.S. Department of Labor)	1% ☐	4% ☐	28% ☐	54% ☐	(56/0)	12%
h) Self-Directed Search, and related publications using the Holland Occupational Classification (e.g., Strong-Campbell Interest Inventory, Vocational Preference Inventory)	17% ☐	10% ☐	25% ☐	38% ☐	(57/0)	10%
i) Career Guidance System, and related publications (Time Share Corporation)	6% ☐	11% ☐	27% ☐	44% ☐	(58/0)	12%
j) Occupational and Career Exploration Kits, and related publications (Science Research Associates)	15% ☐	16% ☐	27% ☐	34% ☐	(59/0)	8%
k) Occupational Library and related publications (Chronicle Guidance Publications)	16% ☐	13% ☐	26% ☐	35% ☐	(60/0)	10%
l) Worker Trait Group Guide, and related publications (Appalachia Educational Laboratory)	4% ☐	5% ☐	29% ☐	50% ☐	(61/0)	12%

Please list any other sources of occupational information that you use regularly:

______________________________ (62-67)

____

______________________________ ________

17. We would be interested in learning more about the experiences of a subset of people to whom we have sent this questionnaire. Would you be willing to respond over the telephone to more detailed questions about your use of occupational information?

44% 1 ☐ Yes 50% 2 ☐ No 6% NA (68/1)

If YES, please supply us with your name and a telephone number where we can reach you during the day.

______________________________ (Name)

______________________________ (Area Code) (Number)

Please place questionnaire in self-addressed postage-paid envelope and return it to us.
Thank you for your assistance.

NATIONAL RESEARCH COUNCIL
ASSEMBLY OF BEHAVIORAL AND SOCIAL SCIENCES
2101 Constitution Avenue Washington, D. C. 20418

COMMITTEE ON OCCUPATIONAL
CLASSIFICATION AND ANALYSIS

April 13, 1979

Dear Sir or Madam:

We are assessing the present use of and future need for the *Dictionary of Occupational Titles* (DOT) and other publications of the Department of Labor's Occupational Analysis program. In order to make informed judgments, we are collecting relevant information from users of these publications. Therefore, we would greatly appreciate your assistance in completing the enclosed questionnaire, which is being sent to users of the *Dictionary of Occupational Titles* in state and local governments. Your name was provided to us by your state's Occupational Information Coordinating Committee (SOICC).

Your participation in this survey is completely voluntary. All the information you give will be protected under the Privacy Act of 1974. This means that your answers will be kept strictly confidential. Results of the study will be made public only in summary or statistical form so that individuals who participate cannot be identified.

We also welcome any other information you might wish to provide on your use and/or evaluation of the *Dictionary of Occupational Titles* and other Occupational Analysis publications. If you have any questions concerning this inquiry, please call Patricia Roos collect (202-389-6345). We would appreciate it if you would complete and return the enclosed questionnaire within the coming week. Thank you for your cooperation.

Sincerely,

Donald J. Treiman
Study Director

Enclosure

OMB No. 445-79005
Approval Expires 12/31/79

SOICC (N = 186)

SURVEY OF PURCHASERS OF THE *DICTIONARY OF OCCUPATIONAL TITLES* CONDUCTED BY THE NATIONAL RESEARCH COUNCIL

The accompanying letter requests your assistance in this survey of recent purchasers of the *Dictionary of Occupational Titles*. **Please read the instructions** carefully and answer by printing your reply or entering a "✓" in the appropriate box. **Please return** the completed form in the enclosed postage-paid envelope to the Committee on Occupational Classification and Analysis, National Academy of Sciences, JH820, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

NOTE: All information you provide will be treated as confidential and used for statistical purposes only.

1708 (1-4)

1 ___ (5-6)

1. Sex 72% 1 ☐ Male 26% 2 ☐ Female 3% NA (11/9)

2. Please indicate the type of employer for whom you work (please be as specific as possible) (12-13/99)

0% 1 ☐ Library
4% 2 ☐ High School, Jr. High
5% 3 ☐ Technical, Vocational, or Trade School
14% 4 ☐ College or University
0% 5 ☐ Federal Government
* 6 ☐ State Government-Employment Service
62% 7 ☐ State Government (other)
8% 8 ☐ County/Local Government
0% 9 ☐ Labor Union
4% 10 ☐ Other private non-profit organization/community group (please specify) ______
0% 11 ☐ Private, profit-making business employing less than 100 workers
0% 12 ☐ Private, profit-making business employing between 100 and 499 workers
0% 13 ☐ Private, profit-making business employing 500 or more workers
0% 14 ☐ Self-employed
0% 15 ☐ Not presently employed
2% 16 ☐ Other (please specify) ______

3. Please check the category which best characterizes the type of work you do (14-15/99)

18% 1 ☐ Career or Vocational Counseling
8% 2 ☐ Rehabilitation Counseling
26% 3 ☐ Vocational Education
8% 4 ☐ Job (employment) Placement
2% 5 ☐ Personnel Management
5% 6 ☐ Labor Force Projections (Manpower Planning)
15% 7 ☐ Occupational Information Development and Dissemination
2% 8 ☐ Compensation Administration
2% 9 ☐ Teaching
0% 10 ☐ Librarianship
6% 11 ☐ Research (describe subject area): ______
4% 12 ☐ Other (please specify) ______
4% General Management Admin.

4. Please list any professional, scientific, or trade associations, relevant to your main employment, to which you belong

______ ______ (16-21)

______ ______ ______

5. Have you ever used the *Dictionary of Occupational Titles* in your work?

*1 ☐ Yes 2 ☐ No (22/9)

If YES, go on to question 6

If NO, go to question 15

* Percentages calculated for non-Employment-Service respondents who use the DOT.

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Questions 6 through 14 are for users of the *DICTIONARY OF OCCUPATIONAL TITLES*

6. A. Which of the following volumes of the *Dictionary of Occupational Titles* have you **ever used?**

B. How frequently have you used the various *Dictionary of Occupational Titles* volumes in your work within the **past year?**

A. *Ever used?* (Check all that apply)			B. Frequency of u e within the past year Regularly (1)	Occasionally (2)	Never (3)		NA
22% ☐	First or second edition (1939, 1949)	(23/9)	4% ☐	13% ☐	28% ☐	(29/9)	55%
68% ☐	3rd edition Volume One: "Definitions of Titles" (green hardback, 1965)	(24/9)	23% ☐	39% ☐	16% ☐	(30/9)	23%
77% ☐	3rd edition Volume Two: "Occupational Classification, Industry Index, Worker Traits Arrangements of Titles and Codes" (green hardback, 1965)	(25/9)	20% ☐	40% ☐	19% ☐	(31/9)	20%
48% ☐	3rd edition Supplement One: "Selected Characteristics of Occupations (Physical Demands, Worker Characteristics, and Training Times)" (green paperback or hardback, 1966)	(26/9)	13% ☐	30% ☐	20% ☐	(32/9)	31%
45% ☐	3rd edition Supplement Two: "Selected Characteristics of Occupations by Worker Traits and Physical Strength" (grey paperback, 1968)	(27/9)	11% ☐	30% ☐	22% ☐	(33/9)	38%
74% ☐	4th (present) edition (red paperback, 1977)	(28/9)	36% ☐	38% ☐	12% ☐	(34/9)	14%

7. A. Which information from the *Dictionary of Occupational Titles* and supplements have you ever used? (Check all that apply)

90% ☐ Job Titles and Definitions (35/9)
31% ☐ Industrial Designation Arrangements (36/9)
80% ☐ Occupational Codes and/or Classification (37/9)
46% ☐ Worker Trait Groups (3rd ed.; vol. 2) (38/9)
37% ☐ General Educational Development (GED) estimates (3rd ed.; vol. 2 or supplement #2) (39/9)
52% ☐ Specific Vocational Preparation (SVP) estimates (3rd ed.; vol. 2 or supplement #2) (40/9)
40% ☐ Interest, Aptitude, and Temperament information (3rd ed.; vol. 2) (41/9)
38% ☐ Environmental and Physical Working Conditions information (3rd ed.; vol. 2 or supplement #2) (42/9)

B. How have you used this information? ______________________________ (43-48)

____

______________________________ ....

8. Have you ever used the *Dictionary of Occupational Titles'* ratings of the level of worker functioning in relation to Data, People, and Things (the 4th through 6th digits of the *Dictionary of Occupational Titles'* codes)?

41% 1 ☐ Yes 55% 2 ☐ No 3% NA (49/9)

If YES, would you describe for what purpose you use these ratings:

______________________________ (50-55)

____

______________________________ ....

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9. Consider the main purpose for which you use the *Dictionary of Occupational Titles*. How adequate is it for this purpose?

56 % 1 ☐ Very adequate 37 % 2 ☐ Somewhat adequate 3% 3 ☐ Inadequate 4 % NA (56/9)

Please detail any inadequacies: (57-62)

10. How would it affect your work if no further editions of the *Dictionary of Occupational Titles* were produced?

13 % 1 ☐ Would not be affected 38% 3 ☐ Would cause major inconvenience (63/9)

36 % 2 ☐ Would cause minor inconvenience 11 % 4 ☐ Would seriously disrupt work

2 % NA

If it would cause inconvenience or disrupt work please elaborate: (64-69)

11. If the *Dictionary of Occupational Titles* were unavailable, are there substitute sources to which you could turn for the same information?

28 % 1 ☐ Yes 32 % 2 ☐ No 37 % 8 ☐ Don't know 2 % NA (70/9)

If YES, please list or describe them: (71-76)

1708 (1-4)

2 (9)

12. Compared with the 4th edition, how could future editions of the *Dictionary of Occupational Titles* be improved to better meet your needs? (please check all with which you agree)

42 % ☐ Use of hard cover (11/9)

28 % ☐ Division into two or more volumes for greater ease in usage (12/9)

32 % ☐ More frequent publication (13/9)

54 % ☐ Inclusion of career ladders (14/9)

44 % ☐ Inclusion of worker trait ratings of General Educational Development (GED) and Specific Vocational Preparation (SVP) (15/9)

45 % ☐ Inclusion of worker trait ratings of interests, aptitudes, and temperaments (16/9)

42 % ☐ Inclusion of worker trait ratings on physical demands and working conditions (17/9)

37 % ☐ Explicit incorporation of Standard Occupational Classification (SOC) codes (18/9)

11 % ☐ Inclusion of additional occupations (please specify): (19/9)

16 % ☐ Other suggested improvements: (20/9)

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13. What do you regard as the most valuable features or contributions of the *Dictionary of Occupational Titles*? (please check all that apply)

64% ☐ DOT codes (21/9)
4% ☐ Job titles and definitions (22/9)
53% ☐ Occupational group arrangement—job families (23/9)
42% ☐ Worker functions (complexity of relationship to Data, People, or Things) (24/9)
41% ☐ Worker trait information (GED, SVP, interests, aptitudes, and temperaments, physical demands and working conditions) (25/9)
2% ☐ Other valuable features or contributions (please specify): ______ (26/9)

14. How would you rate the *Dictionary of Occupational Titles* with respect to the following criteria:

	Very Adequate (1)	Somewhat Adequate (2)	Inadequate (3)	Don't Know (8)		NA
a) Coverage of the types of jobs in which women usually predominate	19% ☐	27% ☐	6% ☐	38% ☐	(27/9)	9%
b) Coverage of the types of jobs in which minorities usually predominate	14% ☐	24% ☐	9% ☐	42% ☐	(28/9)	10%
c) Rating of worker functions and traits for jobs in which women usually predominate	15% ☐	19% ☐	9% ☐	45% ☐	(29/9)	13%
d) Rating of worker functions and traits for jobs in which minorities usually predominate	12% ☐	18% ☐	9% ☐	48% ☐	(30/9)	12%

Please elaborate: ______ (31-36)

15. In addition to the *Dictionary of Occupational Titles*, the Occupational Analysis program distributes occupational information in other forms. We are also interested in the frequency with which you may use these brochures or pamphlets. During the **past year**, how frequently have you used the following Occupational Analysis publications in your work?

	Regularly (1)	Occasionally (2)	Never (3)	Not familiar with publication (4)		NA
a) Career Opportunities in the Telephone and Telegraph Industries (1977)	1% ☐	13% ☐	24% ☐	52% ☐	(37/9)	10%
b) Career Opportunities in the Trucking Industry (1978)	0% ☐	18% ☐	23% ☐	50% ☐	(38/9)	8%
c) Handbook for Analyzing Jobs (1972)	6% ☐	19% ☐	19% ☐	50% ☐	(39/9)	6%
d) Health Careers Guidebook (1973)	4% ☐	21% ☐	22% ☐	44% ☐	(40/9)	9%
e) Job Descriptions and Organizational Analysis for Hospitals and Related Health Services (1971)	5% ☐	16% ☐	20% ☐	49% ☐	(41/9)	10%
f) Job Guide for Young Workers (1970)	3% ☐	16% ☐	20% ☐	52% ☐	(42/9)	9%
g) Occupations in Electronic Computing Systems (1972)	1% ☐	14% ☐	24% ☐	51% ☐	(43/9)	10%
h) Occupations in Library Science (1973)	1% ☐	9% ☐	26% ☐	54% ☐	(44/9)	10%
i) Task Analysis Inventories (Series 1) (1973)	2% ☐	15% ☐	22% ☐	50% ☐	(45/9)	12%
j) Job Bank Openings Summary (JBOS; monthly)	10% ☐	19% ☐	22% ☐	40% ☐	(46/9)	9%
k) Frequently Listed Openings (JOB-FLS; monthly)	8% ☐	23% ☐	18% ☐	40% ☐	(47/9)	11%
l) Occupations in Demand (OID; monthly)	11% ☐	26% ☐	17% ☐	38% ☐	(48/9)	9%
m) Labor Market Information Analytical Table Series (LMI-ATS; monthly)	5% ☐	23% ☐	16% ☐	49% ☐	(49/9)	7%

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16. Below is a list of other occupational information publications, from both government and non-government sources. Please indicate the frequency with which you have used them in your work within the past year.

	Regularly (1)	Occasionally (2)	Never (3)	Not familiar with publication (4)		NA
a) Bureau of Labor Statistics Wage Surveys (e.g., Area Wage Surveys, Municipal Wage Surveys)	16% ☐	46% ☐	17% ☐	16% ☐	[illegible]	6%
b) Occupational Outlook Handbook (Bureau of Labor Statistics)	44% ☐	41% ☐	8% ☐	4% ☐	[illegible]	3%
c) International Standard Classification of Occupations (International Labour Office)	2% ☐	6% ☐	36% ☐	47% ☐	[illegible]	10%
d) Office of Education Classification System (U.S. Department of Health, Education, and Welfare and U.S. Department of Labor)	19% ☐	25% ☐	21% ☐	30% ☐	[illegible]	6%
e) Standard Occupational Classification (U.S. Office of Federal Statistical Policy & Standards)	9% ☐	25% ☐	23% ☐	36% ☐	[illegible]	8%
f) U.S. Bureau of the Census publications (e.g., Occupational Characteristics of the Population, Alphabetical Index of Occupations, Classified Index of Occupations)	11% ☐	36% ☐	19% ☐	27% ☐	[illegible]	6%
g) Handbook of Occupational Keywords (U.S. Department of Labor)	3% ☐	10% ☐	30% ☐	52% ☐	[illegible]	6%
h) Self-Directed Search, and related publications using the Holland Occupational Classification (e.g., Strong-Campbell Interest Inventory, Vocational Preference Inventory)	10% ☐	13% ☐	28% ☐	43% ☐	[illegible]	5%
i) Career Guidance System, and related publications (Time Share Corporation)	5% ☐	22% ☐	30% ☐	38% ☐	[illegible]	5%
j) Occupational and Career Exploration Kits, and related publications (Science Research Associates)	6% ☐	23% ☐	33% ☐	32% ☐	[illegible]	5%
k) Occupational Library, and related publications (Chronicle Guidance Publications)	7% ☐	16% ☐	31% ☐	41% ☐	[illegible]	5%
l) Worker Trait Group Guide, and related publications (Appalachia Educational Laboratory)	6% ☐	14% ☐	32% ☐	44% ☐	[illegible]	4%

Please list any other sources of occupational information that you use regularly:

____________________ [illegible]

____

____________________ ________

17. We would be interested in learning more about the experiences of a subset of people to whom we have sent this questionnaire. Would you be willing to respond over the telephone to more detailed questions about your use of occupational information?

56% 1 ☐ Yes 36% 2 ☐ No 8% NA [illegible]

If YES, please supply us with your name and a telephone number where we can reach you during the day.

____________________ ____________________

(Name) (Area Code) (Number)

Please place questionnaire in self-addressed postage-paid envelope and return it to us.
Thank you for your assistance.

APPENDIX

B Site Visits to Selected Federal Users of the *Dictionary of Occupational Titles*

PATRICIA A. ROOS

The staff conducted site visits to three federal users of the *Dictionary of Occupational Titles*. The agencies chosen for detailed analysis were selected because they "rode the requisition" for the DOT, that is, they purchased the DOT in large quantities supplementary to the Employment Service's purchase order. These agencies are the Bureau of Apprenticeship and Training of the Department of Labor, the Bureau of Disability Insurance of the Social Security Administration, and the Veterans Administration. The Department of the Navy purchased multiple copies (1,250) of the DOT; however, since these copies went directly into storage, the committee staff felt that a visit to the Department of the Navy would not be a fruitful one.

BUREAU OF APPRENTICESHIP AND TRAINING

In the Bureau of Apprenticeship and Training (BAT) the primary user and the office originating an order for 1,000 copies of the *Dictionary of Occupational Titles* is the Division of Review and Registration (DRR). The staff of the national office of BAT oversees the registration of apprenticeship programs, a procedure that involves an evaluation of whether the occupation to be apprenticed meets the criteria of eligibility (apprenticeability) required by BAT. From the national office, copies of the DOT were distributed to BAT representatives at the 10 regional offices and all the field offices. A copy of the DOT was also given to each of the 32 state apprenticeship councils, which coordinate their work with BAT as well as to some of the larger program sponsors of apprenticeship programs. There are currently 543 apprenticeable occupations recognized by the Bureau of Apprenticeship and Training. The number of people being trained for these occupations has risen from 26,137 in 1941 to 262,586 in 1977. The DOT is a primary source book in the evaluation of a proposed apprenticeship program—no program can be registered with BAT if the corresponding occupation does not have a DOT code.

The Bureau of Apprenticeship and Training was established as the primary agency within the Department of Labor responsible for ensuring compliance with, and carrying out the objectives of, the National Apprenticeship Law of 1937. Though the bureau is not involved in the training itself, it works closely with employers, unions, state apprenticeship agencies, and vocational schools to set up and monitor apprenticeship programs across the country. Responding to proposals for apprenticeship programs initiated at the local level, the Division of Review and Registration determines whether the occupation to be apprenticed meets BAT criteria and the program meets BAT standards; if so, DRR registers the program with BAT. Although registration of apprenticeship programs with BAT is not required, there are advantages to both employers and employees of such registration. For employers, BAT serves a training and consulting role, at no charge, advising them of the various rules and regulations (e.g., equal employment opportunity regulations) affecting their apprenticeship programs. In addition to its advisory role, BAT also benefits employers by ensuring quality education for apprentices and reducing costly job hopping. For employees, BAT ensures that upon completion of the program, participants will receive journeyman status and wages. The BAT also monitors compliance with the Davis-Bacon Act, which stipulates that in order to pay less than journeyman wages, employers must register their apprenticeship program with either BAT or a state apprenticeship agency recognized by BAT; apprentices are thus guaranteed wage protection. The bureau views its role as one of opening the door for employers and employees to work together for mutual benefit.

USING THE DOT TO EVALUATE THE APPRENTICEABILITY OF OCCUPATIONS

In order to be considered "apprenticeable," occupations must meet certain criteria developed by BAT, the most important of which is that the occupation be a skilled trade (no professional occupations are apprenticed). Another criterion, the one for which the DOT is most frequently used, is that the occupation be one that involves manual, mechanical, or technical skills and knowledge requiring a minimum of 2,000 hours (about

1 year) of on-the-job work experience. Similarly, in order for an apprenticeship program to be registered with BAT, it must include the provision that apprentices receive at least 2,000 hours of on-the-job training.

The initial review concerning the apprenticeability of an occupation begins at the field level, when a potential program sponsor contacts a BAT representative in order to have an apprenticeship program registered. At this point a nine-digit DOT code is assigned to the occupation to be apprenticed. If no such code exists, the national BAT office requests the Division of Occupational Analysis to undertake a complete job analysis study to create one.

Once a nine-digit DOT code is assigned to an occupation to be apprenticed, the DOT is used primarily in verifying that the number of hours of on-the-job training (or term) specified by the program sponsor (in the description of the work process to be completed by the apprentice) matches the specific vocational preparation (SVP) estimate associated with the corresponding journeyman occupation. As mentioned above, an apprenticeship program must require a minimum of 2,000 hours of on-the-job training in order to be registered with BAT. The BAT staff with whom I spoke use the following equivalence between the required term of the apprenticeship program and the SVP estimates in order to verify the length of training time estimated by program sponsors:

Term	SVP Code (and Definitions)
1 year	5 (6 months to 1 year)
2 years	6 (1–2 years)
3–4 years	7 (over 2–4 years)
4 years	8 (over 4–10 years)
not applicable	9 (over 10 years)

As an example, let us suppose that a program sponsor submitted a work process description for an apprentice Wool-and-Pelt Grader and noted that the apprenticeship tenure should be 2 years. The SVP code associated with the journeyman occupation corresponding to an apprentice Wool-and-Pelt Grader is 4, which suggests that the vocational training required is less than 6 months. The BAT staff would thus note that the term specified by the employer did not correspond to the SVP estimate of training time, and since the latter was lower than the required 2,000 hours, the program would not be registered. Since the 2,000-hour rule is also one of the criteria used to determine the apprenticeability of an occupation, a similar matching process takes place in that evaluation. When the term and SVP estimates do not match, there can be two explanations: either the employer overestimated the amount of training needed, or the SVP estimate was miscoded. If the latter is believed to be the case, BAT could recommend that the occupation go back for additional job analysis.

The SVP specification is thus used to make distinctions among occupations in the amount of training time required to reach journeyman status; those occupations not requiring at least 2,000 hours of on-the-job training are not registered by BAT (2,000 hours is equivalent to an SVP level of 5 or above). The SVP estimates used by the bureau are taken from an interim report prepared in February 1978 by the Division of Occupational Analysis (U.S. Department of Labor, 1978b). It will be superseded by the as-yet-unpublished supplement to the fourth edition DOT, "Selected Characteristics of Occupations," which is being financed by the Social Security Administration and includes the entire range of worker traits.

The worker function codes for DATA, PEOPLE, and THINGS are also used by BAT to provide an indication of the skill level of a job—that is, the higher the code, the lower the skill level required. The general education development (GED) scale is also occasionally used to compare the entrance requirements of occupations with the description of the job as provided in the work process report. The DOT definitions themselves are occasionally used to evaluate the adequacy of the work process descriptions provided by the program sponsors. In addition to these specific uses, the DOT codes are used in the State and National Apprenticeship Reporting System (SNAPS), a statistical reporting system that provides a breakdown of the distribution of participants in apprenticeship programs by race, ethnicity, veteran status, and sex.

Other than the DOT, BAT uses two other specially prepared reports of the occupational analysis program. One is the interim report mentioned above, and the other is a frequently used three-volume computer printout that provides a conversion from third edition to fourth edition DOT codes; the printout also lists deletions made between the two editions. A third frequently used source book for occupational information is the *Occupational Outlook Handbook*.

ADEQUACY OF THE DOT

The staff at BAT view the DOT as being crucial to their work. The DOT code itself, the job definitions, and especially the SVP codes are used regularly in evaluating the apprenticeability of occupations and registering apprenticeship programs. Those with whom we spoke made detailed suggestions for improving the fourth edition DOT (e.g., the DOT should be hardbound and in a loose-leaf format).

On a more substantive level, BAT staff would like to see the apprenticeship codes in the fourth edition removed. Since they view apprenticeships as only temporary, BAT staff always use the journeyman code that represents the occupational objective of the apprentice. To include a DOT code for apprentices suggests that permanent apprenticeship occupations exist, a practice that goes against the spirit of apprenticing occupations. It was noted that some of the apprenticeship codes in the fourth edition DOT do not even have a corresponding journeyman code (e.g., 863.364-010, Insulation Worker Apprentice (construction)).

Another problem for BAT with the fourth edition DOT is that some occupations recognized as apprenticeable by BAT were consolidated and not given separate entries in the DOT (and thus not recognized as separate occupations). Further coordination between BAT and the occupational analysis program was suggested in order to correct this problem. Finally, BAT staff would like to see apprenticed occupations noted in some way in the next edition of the DOT; for example, occupations recognized as apprenticeable by BAT could be set in boldface type for easier accessibility by training representatives.

BUREAU OF DISABILITY INSURANCE

A request for 2,240 copies of the *Dictionary of Occupational Titles* originated from the Medical and Vocational Methods Branch of the Bureau of Disability Insurance (BDI), an agency in the Social Security Administration (SSA). The Medical and Vocational Methods Branch is concerned with the formulation and dissemination of policy concerning the medical definition of disability. From BDI, copies of the DOT were distributed to the Bureau of Hearings and Appeals (the appellate level) and to the 10 regional offices for distribution to state disability agencies.

Eligibility for benefits under Title 2 of the social security legislation depends on establishing that a person's disabilities are debilitating in the sense that they keep him or her from being employed in the same or "similar" work that he or she has performed in the past. The legislation's definition of disability mandates that a person's ability to perform alternative work be evaluated before disability benefits are awarded. According to BDI personnel the DOT has become the primary source document used in this evaluation. At the time of the site visit, SSA personnel were not employing the fourth edition DOT, since the relevant supplement, *Selected Characteristics of Occupations (Physical Demands, Working Conditions, Training Times)*, for which the Social Security Administration contributed $50,000, was not yet published. (A similar supplement had been prepared for the third edition (U.S. Department of Labor, 1966).)

The determination of whether disability allowances should be awarded may be made solely on the basis of a medical assessment of disability. However, if examiners cannot adjudicate on the basis of medical evidence alone, they use the DOT to make an assessment of what functions the individual is able to perform, that is, they make a determination of his or her "residual functional capacity." This assessment involves the development of a vocational profile based on an evaluation of the physical exertion and skill levels of past employment. This profile can then be matched against recommended alternative employment to determine whether, with a given disability, an individual is capable of performing "substantial gainful employment." If not, disability benefits are allowed.

USING THE DOT TO DETERMINE DISABILITY AWARDS

The processing of disability claims begins at the local social security office when an individual comes in to file for disability benefits. A claims representative interviews the client and writes up a description of the client's disability and work experience for the past 15 years. The claim is then transmitted to the Disability Determination Section (DDS) of the state's vocational rehabilitation agency, where an adjudicator assembles the relevant medical and vocational evidence. On the basis of this evidence the adjudicator determines whether the individual should be awarded benefits on the basis of medical evidence alone or whether alternative employment exists in which the individual could find work. The primary role of the vocational specialists at the Medical and Vocational Methods Branch (national office) is in mediating disability disputes between the local district offices and the state DDS. The role of mediator usually involves interpreting the Social Security Administration's rules and regulations as they relate to recommending jobs for the disabled claimant. Disputes usually involve an evaluation of the transferability of the claimant's skills to recommended other employment.

The DOT is used primarily for making an assessment of the kind of employment the claimant can perform, given the disability incurred and his or her past employment. The underlying principle employed in the evaluation process is that if the physical, mental, and skill levels of the disabled individual match the physical, mental, and skill demands of his or her previous employment, disability benefits are not allowed. If the individual cannot perform his or her past employment, a determination is then made as to whether there exist other jobs in the national economy (without regard to whether such jobs are locally available) that the disabled person could perform (e.g., work similar to previous employment but perhaps requiring less exertion).

Various volumes and supplements of the DOT are used in assessing the physical, mental, and skill levels of previous work experience and potential employment. In determining whether skills are transferable between past and alternative employment (i.e., whether recommended jobs are appropriate), vocational specialists occasionally use the following questions as general guidelines:

1. Are jobs at the same or a lower skill level? (Jobs at higher skill levels are not recommended.)
2. Do new jobs involve the same or similar tools?
3. Do recommended jobs involve similar processing and products?

These guidelines are merely suggestive, since "appropriate" employment does not necessarily have to be similar to previous employment on all three factors.

This determination of the transferability of skills between past and potential employment is made by referring to Supplement One of the third edition DOT, *Selected Characteristics of Occupations*, since the relevant fourth edition supplement has not yet been published. This volume contains information on worker trait groups, industry, physical demands, working conditions, and the GED and SVP training time specifications, all of which are employed to develop a vocational profile of the claimant. In order to ensure that recommended jobs are not at a higher skill and function level than previous employment, the analyst uses the worker function specifications of DATA, PEOPLE, and THINGS. It is assumed that the higher the worker function score, the lower the skill level of the occupation. For example, if the person's previous employment had a worker function score of 884, the analyst would seek other "884" jobs that are similar in other ways (such as being in the same industry) either by referring to the DOT classification in Supplement One to find other jobs clustered near the original occupation or by referring to the worker trait groups (in which jobs with the same worker traits are arranged together), provided in Volume 2 of the third edition DOT. Jobs that are likely possibilities are then checked by referring to the job definitions and job characteristics. In order to be considered appropriate alternative work, recommended jobs must not have DATA, PEOPLE, and THINGS codes lower (skill level higher) than the codes of the claimant's past work experience.

A similar sort of comparison process is carried out with the GED and SVP specifications, which are taken to represent another part of the claimant's job profile. In order to be considered appropriate, recommended jobs must be at the same or similar levels of GED and SVP, which are also loosely taken as measures of the skill level of the job. Although the analysts do not translate GED codes into years of schooling, a general rule of thumb is to call jobs in levels 1 and 2 "unskilled" and to call jobs in levels 3 and above "skilled."

The third component of the composite job profile takes into consideration the physical demands and the working conditions of the job. The physical demands assessed are the amount of strength (whether the job is sedentary or whether it requires light, medium, heavy, or very heavy lifting), the need to climb, balance, stoop, kneel, crouch, crawl, reach, handle, finger, feel, talk, hear, and see. The working conditions defined by the DOT include whether the job is typically performed indoors, outdoors, or both and whether it involves extremes of heat or cold, wetness, humidity, noise, vibration, hazards, fumes, odors, toxic conditions, dust, or poor ventilation. These characteristics of recommended jobs can be compared with the job profiles developed for the claimant's previous employment in order to find matches at lower levels of exertion that the individual can potentially perform, given his or her disabilities. The principle involved in the comparison includes determining whether, given the particular physical and/or mental impairment, the individual can do the job.

ADEQUACY OF THE DOT

The BDI personnel interviewed felt that there were no other occupational source books that came close to providing the information currently existing in the DOT. They felt that if the DOT were to be discontinued, their judgments regarding the determination of disability would be more speculative and unrealistic: adjudicators would have to make decisions solely on the basis of medical evidence without giving appropriate weight to the vocational background of the claimant. Only one minor complaint was offered about the DOT product itself: analysts occasionally question the function or skill level assigned to a particular occupation. Because problems come up so rarely, there is no formal mechanism set up to apprise the Division of Occupational Analysis so that revisions can be incorporated into future editions of the DOT. The analysts provided two examples of what they consider to be underestimates of the physical exertion required on the job: the job of Nurse's Aide was rated as requiring only light lifting, while BDI staff believe that it should have a rating of "medium"; the job of Motorman in a mine was also rated as requiring only light lifting, while BDI staff felt it should have a rating of "medium."

VETERANS ADMINISTRATION

The Veterans Administration (VA) ordered 520 copies of the fourth edition *Dictionary of Occupational Titles.* The office initiating this request was the Counseling and Rehabilitation Section of the Division of Education and Rehabilitation Service. From this office the dictionaries were distributed to 58 regional offices. The VA site visit was conducted at the Washington, D.C., regional office of the Counseling and Rehabilitation Section (C&R) so as to gain awareness of how the DOT is used in the field offices. During fiscal 1977 the D.C. regional office provided readjustment benefits to 20,439 people and awarded $11,542,358 in monetary benefits. During fiscal 1978, approximately 2,400 veterans received counseling through this office; the majority of these people are disabled veterans who are required to undergo rehabilitation counseling in order to file for benefits.

The Veterans Administration is responsible for carrying out the provisions of Title 38 of the U.S. Code—Veterans Benefits. The C&R oversees the implementation of four chapters of Title 38:

1. Chapter 34, the GI Bill, offers educational assistance to veterans who entered the military prior to January 1, 1977.
2. Chapter 32 provides similar assistance for those veterans who entered the military on or following January 1, 1977.
3. Chapter 35, the Dependents Program, offers educational assistance to war orphans or dependents of permanently disabled veterans.
4. Chapter 31, the Disabled or Vocational Rehabilitation Program, provides rehabilitative counseling and vocational training and makes recommendations for the payment of benefits to service-disabled veterans.

The D.C. regional office serves an idiosyncratic clientele because of its location. Many of the clients receiving counseling or benefits through this office are eventually employed in government jobs. Another feature of the D.C. clientele is that it is highly educated or, more specifically, in the process of becoming highly educated. Of the 635 veterans currently receiving educational assistance through the D.C. office, approximately 500 are in college programs, most of which are 4-year programs.

USING THE DOT IN COUNSELING AND REHABILITATION

Veterans who use the services of the Counseling and Rehabilitation Section may do so by choice or because their attendance is mandatory. Disabled veterans must undergo counseling if they wish to take advantage of the veterans' assistance benefits under Title 38; other veterans are not required to undergo counseling but may choose to do so. Once a veteran is adjudged eligible for counseling and/or rehabilitation services, he or she is given an appointment with a counseling psychologist (CP). Although one of the services of the CP's is personal psychological counseling, they use the DOT primarily in their role as occupational or vocational counselors in exploring the client's vocational plans and developing occupational objectives. Once the client and the counselor agree on an occupational objective, the six-digit third edition DOT code (the VA plans to switch to the nine-digit fourth edition code shortly) is assigned to identify that objective. In addition to using the DOT code to identify the occupational objective, the counselors use the DOT for occupational exploration. They use the DOT in this context to define tasks within each occupation or job so that the client can determine which jobs are well suited to his or her constellation of skills and/or interests.

Following the interview with the counseling psychologist, disabled veterans (or dependents who are themselves disabled) meet with vocational rehabilitation specialists (VRS) who supervise their retraining. The VRS's, in consultation with the client, make recommendations regarding the particular rehabilitative training that the client should undergo and the benefits that should be paid. In this context the VRS also uses the six-digit DOT code identified previously to define the agreed-on occupational objective. In the role of rehabilitative specialist the VRS uses the DOT job definitions to determine whether the client can perform the various tasks involved in such employment. In this context the VRS often checks on the physical and environmental attributes of the occupation, as provided in the third edition DOT, to verify the suitability of the employment for the particular client.

The fourth edition DOT job definitions are used in a variety of ways by the counselors. Counselors remarked that they often encourage their clients to read through various job definitions to get an idea of the tasks involved in particular occupations in order to determine which are most suitable for them, given their interests and skills. One counselor remarked that she had clients read through the task descriptions in order to help them prepare résumés for job interviews by reminding them what tasks were involved in their previous occupations. The job definitions are also used when disagreements arise between the veteran and the professional staff regarding "suitable employment." If a veteran disagrees with the assessment of the counselor, the case can go before the Board of Veterans Appeals. In such a situation the counselor prepares a statement of the case, citing relevant laws and regulations. In this context he or she often references the DOT to document the case by describing the tasks inherent in a particular occupational category.

None of the staff with whom we spoke used the military occupation codes or definitions, which were added to the fourth edition DOT. Since they are interested only in the transferability of military skills to civilian occupations, they found no use for codes that refer to military-specific occupations. In fact, they used the military occupational specialty (MOS) itself only when it involved skills that were directly transferable to desired civilian occupations.

The counselors do not make use of either the GED and SVP estimates or the supplement to the third edition DOT funded by the Social Security Administration, *Selected Characteristics of Occupations (Physical Demands, Working Conditions, Training Times)*. They did, however, mention that they used the physical and environmental attributes of occupations, provided in the worker trait section of the third edition DOT. Their use of these attributes is not exploratory, in the sense of searching out occupations particularly suited to people with specific handicaps. Counselors use them instead as a validation mechanism to ascertain whether a client will be able to perform a particular occupation, given his or her service-related disabilities.

Counselors also use the worker function data from the DOT in conjunction with other occupational exploration material such as the *Strong-Campbell Interest Inventory* and Holland's *Self-Directed Search*. Once an occupation or set of occupations has been targeted via the self-directed search method, the client has specific DOT titles and codes with which to work. From this point the counselor can work backward, using the relationship to data, people, and things codes to verify that the occupations are appropriate given the client's interests, skills, and self-descriptions. For example, if a person is interested in working with people and the results from the psychological testing confirm this, the counselor uses the PEOPLE code (the fifth digit of the DOT code) to verify that the occupational objectives they are discussing indeed involve significant interaction with people.

ADEQUACY OF THE DOT

On the whole the counselors view the existence of the DOT as crucial to their work. The DOT code itself is basic to maintaining statistical records on occupational objectives of veterans. The job definitions, with their detailed description of the constituent tasks involved in particular occupations, assist the counselors in developing educational and occupational objectives with their clients. However, the C&R staff did have some detailed suggestions for improving the fourth edition DOT.

The first suggestion has to do with the physical packaging of the product. The fourth edition, they believe, is too unwieldy to use efficiently, owing to its bulk and its soft cover. Their recommendation is that it be produced as two hard-covered volumes. In addition, one counselor mentioned that the alphabetical listing is too difficult to use, since it is buried in the middle of the book.

Another common criticism is that important titles are still missing, especially titles specific to the government sector. The particular titles mentioned were intake worker, accounting technician, accounting clerk, and various paraprofessional occupations. The counselors recommended that all civil service occupations be incorporated directly into the DOT.

It was also noted that many occupations are not easy to find in the DOT because of the high degree of cross-referencing. Finally, the staff expressed a desire for more training on the use of the worker function data of the DOT, since many of them were uncomfortable with the actual use of the DATA, PEOPLE, and THINGS codes. They felt that they understood the concept but lacked any real ability to apply that knowledge to vocational planning in other than a very primitive way.

APPENDIX

C

Annotated Bibliography of Research Uses of the *Dictionary of Occupational Titles*

JUNE PRICE

Algra, Cecelia
1978 Meeting the challenge of a minimum reading graduation requirement. *Journal of Reading* 21(February):392–397.

This article describes the development of a minimum reading requirement for high school graduation, with tests based on comprehension and validated within the working community. Occupations that are classified as being above the menial level in the DOT and that require some reading ability were studied to set a reading criterion for successful employment at the entry level.

Anderson, Harry E., Jr., S. Larry Roush, and Jack E. McClary
1973 Relationships among ratings, production, efficiency, and the General Aptitude Test Battery scales in an industrial setting. *Journal of Applied Psychology* 58 (August):77–82.

The GATB assesses worker aptitudes that relate directly to the DOT's worker trait aptitude scales. In this study, relationships among GATB scales, job-related behavior (supervisor's ratings), and actual production and efficiency rates were examined for 76 coil winders in an overhead distribution transformer plant. In terms of published strategies applied in selection and placement activities, the use of the GATB was found to be deficient in several respects. The correlations between the GATB scales and the rating, production, and efficiency variables were found to be low to insignificant, including more than one third that were negative. These results indicate a need for further evaluation of the GATB in industrial settings.

Ashley, William L.
1977 *Occupational Information Resources: A Catalog of Data Bases and Classification Schemes*. Information Series No. 104. Columbus: Ohio State University, Center for Vocational Education.

This catalogue seeks to provide a basic reference to existing data and to stimulate creative thinking regarding new ways of looking at occupational mobility and transfer. It was designed and compiled for the primary purpose of assisting researchers in the study of factors related to occupational mobility and skill transfer within and between occupations. The catalogue consists of two major parts: section 1 contains the abstracts of the occupational data bases, and section 2 contains the abstracts of occupational classification schemes. Included in section 2 are abstracts and descriptions of the various sections of the third edition DOT, Volumes 1 and 2, as well as the General Aptitude Test Battery.

Baer, Max F., and Edward C. Roeber
1951 *Occupational Information*. Chicago: Science Research Associates, Inc.

Designed to serve as both a handbook for professional occupational guidance counselors and a textbook for the counselor in training, this book provides an overall picture of the country's occupational structure, reviews and provides a guide to occupational literature, and offers suggestions on the development of a library of occupational information. The authors describe the structure, content, and uses of the DOT and mention other systems of occupational classification that incorporate the DOT information.

Barker, Donald G.
1969 Factor analysis of worker trait requirements. *Journal of Employment Counseling* 6(December):162–168.

Factor analysis of a sample of the 4,000 jobs listed in *Estimates of Worker Trait Requirements for 4,000 Jobs as Defined in the Dictionary of Occupational Titles*, rated on 48 worker trait requirements, yielded nine interpretable orthogonal factors or patterns of employment qualifications: (1) technical, (2) clerical, (3) manipulative, (4) persuasive, (5) color discrimination (perhaps artistic), (6) administrative, (7) scientific, (8) social service, and (9) agility.

Barker, Donald G.
1971 Color perception requirements of 4,000 jobs. *Journal of Employment Counseling* 8(March):26-30.

Tabulation of the color discrimination requisites of a representative sample of jobs analyzed in the *Estimates of Worker Trait Requirements for 4,000 Jobs* revealed that the majority of jobs require little or no color perception aptitude. Only 2 percent of jobs require above average color discrimination. These occupations were listed by second and third edition DOT codes and titles for the use of counselors in the guidance of clients with defective color vision.

Bemis, Stephen E., Robert L. Bonner, Thomas F. Kearney, and Kathleen Goppold von Lobsdorf
1973 Development of a new Occupational Aptitude Pattern structure for the GATB. *Vocational Guidance Quarterly* 22(December):130–135.

The General Aptitude Test Battery (GATB) and the derived occupational aptitude patterns (OAP's) are described. A lengthy analysis of the many Specific Aptitude Test Batteries that have been developed over the years produced 43 new tentative

OAP's. The difficulties in relating the two systems are discussed. Final developmental work and the resulting OAP structure will be presented in a subsequent article (see Bemis et al., 1974).

Bemis, Stephen E., Robert L. Bonner, Thomas F. Kearney, and Kathleen Goppold von Lobsdorf
1974 The new Occupational Aptitude Pattern structure for the GATB. *Vocational Guidance Quarterly* 22(March):189–194.

The authors describe their attempts at developing a rationale for relating occupational aptitude patterns (OAP's) to the worker trait groups of the third edition DOT, toward organizing occupations within an OAP and adding related occupations. The OAP structure resulting from this research consists of 62 three-aptitude, multiple-hurdle patterns that incorporate 1,215 occupations. Each OAP consists of the most significant aptitudes and the critical scores on these aptitudes established as minimum scores for groups of occupations having similar aptitude requirements.

Berg, Ivar
1970 *Education and Jobs: The Great Training Robbery*. New York: Praeger Publishers.

Berg's analysis investigates the relation between education and employment, specifically the role of educational attainment in generating job opportunities. Of special concern is employers' use of educational requirements in determining job requirements. Using the GED ratings from the 1956 and 1966 worker trait analyses, Berg first translated the seven-level GED code to a generally accepted years-of-schooling equivalent. The 1956 and 1966 GED scores were then used as gross estimates of the educational requirements of the jobs held for the two census years, 1950 and 1960. These estimates of job requirements with respect to education were then compared with the achieved education of the labor force. The two dates made it possible to include the effects of changes in estimated requirements as well as in the distribution of people among jobs. Berg suggests that since achievements appear to have exceeded requirements in most job categories, it cannot be argued that technological and related changes attending most jobs account for the pattern whereby better educated employees are required and made use of by managers.

Bjorkquist, David C.
1970 Technical education for the underemployed and unemployed. *Vocational Guidance Quarterly* 18(June):264–272.

Two manpower development and training programs in the field of mechanical technology were compared. High school graduates with satisfactory General Aptitude Test Battery scores on intelligence, numerical, and spatial ability were enrolled in either a job-oriented or field-oriented program. Evaluation was based on achievement during training, social class identification, job responsibilities, job satisfaction, mobility, unemployment, employer ratings, and salaries. Job responsibilities were analyzed using the third edition DOT's DATA, PEOPLE, and THINGS scales. Results did not indicate the overall superiority of one training program to the other.

Borgen, Fred H., David J. Weiss, Howard E. A. Tinsley, Rene V. Dawis, and Lloyd H. Lofquist
1972 *Occupational Reinforcer Patterns.* Volume 1. Minneapolis: University of Minnesota, Department of Psychology, Vocational Psychology Research.

Occupational Reinforcer Patterns (ORP's) for 81 occupations are presented alphabetically, using the third edition DOT titles. An ORP describes the stimulus conditions available in the work environment for the satisfaction of workers' needs. Satisfaction is predicted for those whose needs (as measured by the Minnesota Importance Questionnaire) correspond with the ORP for a given occupation; a discrepancy between needs and ORP's is likely to result in dissatisfaction. The ORP's are based on the combined Minnesota Job Description Questionnaire (MJDQ) ratings of supervisors of each occupation. Four types of information are presented: (1) a profile of occupational reinforcers, in graphic form, (2) a list of characteristics for each occupation, which are highly descriptive or moderately descriptive, (3) a listing of other occupations that have ORP profiles similar to a given occupation, and (4) summary statistics describing scale values and other information about the occupation (for ORP, Volume 2, see Rosen et al. (1972)).

Brolin, Donn
1973 Vocational evaluation: Special education's responsibility. *Education and Training of the Mentally Retarded* 8(February):12–17.

Because many educable mentally retarded persons continue to lead marginal lives after school despite higher potentials, the author asserts that schools can and should provide more relevant, vocationally oriented programs to help eliminate the barriers encountered by the mentally retarded after they leave school. The components of a recommended vocational evaluation program for the schools are described. The third edition DOT is cited as a valuable source for conducting job analyses, which is the first step in developing work and job samples. It is also a suggested reference for assessing occupational ability requirements and reinforcer systems.

Broom, Leonard, Paul Duncan-Jones, F. Lancaster Jones, and Patrick McDonnell
no date Data, People and Things as Non-Vertical Aspects of Jobs: An Evaluation and Modest Research Proposal. Unpublished paper, Australian National University, Canberra.

Sociological analyses of occupational mobility have for the most part focused on "vertical" mobility (usually prestige, social standing, or socioeconomic class). The authors describe in detail the DOT's worker traits and worker functions and suggest that they provide different kinds of variables that are equally important. They note that the use of the DATA, PEOPLE, and THINGS scales in research has been limited by the incompatability of the DOT classification system with the census codes and their accompanying social statistics. In an effort to develop a tool for studying new aspects of mobility patterns, Broom et al. encoded the 1971 Australian Census Classification of Occupations (ACCO) into the DOT framework. An analysis of the relationship between the worker trait groups and worker functions in the DOT and those assigned to the ACCO revealed strong correlations between the two sets of DOT ratings and also verified the reliability of the authors' cross-coding. The article concludes with an outline for future research of occupational mobility patterns using this kind of data.

Broom, Leonard, Paul Duncan-Jones, F. Lancaster Jones, and Patrick McDonnell
1977 Worker traits and worker functions in DOT. *Journal of Vocational Behavior* 11(October):253–261.

This paper, a by-product of an extension of the DOT to the Australian Census Classification of Occupations, attempts to validate the worker function hierarchies in terms of the worker traits required by different jobs in the DOT. It shows empirically that the variation in worker traits across the occupations listed in the DOT is closely reflected in the 197 worker function profiles, which have better research potential.

Brown, Julius S.
1975 How many workers enjoy discretion on the job? *Industrial Relations* 14(May):196–202.

This study attempts to provide a rough estimate of the number of workers who hold jobs that permit discretion, the distribution of such jobs by race and sex, and the pay differentials associated with this variable. Jobs with a DATA or THINGS rating of less than 5 or a PEOPLE rating of less than 6 (according to the DOT) were assumed to be discretionary. The percentage of employed persons who hold discretionary jobs (55 percent) has not changed between 1950 and 1970. Blacks have made some progress over the years; there still is, however, a distortion in favor of whites. In 1970 as in 1950, 70 percent of women were employed in nondiscretionary jobs. Finally, wages for discretionary work have increased faster than for nondiscretionary work.

Brown, Robert A., and Donald A. Pool
1974 Levels of expectation and aspiration in the brain injured. *Journal of Clinical Psychology* 30(January):50–53.

This study examined the behavior of brain-injured subjects on an experimental arithmetic task. Brain-injured subjects were matched with a control group on age, education, and premorbid occupational level as classified by the third edition DOT. Subjects' reported level of expectation and level of aspiration were compared with actual performance on the task. There were no differences between the groups in discrepancy between performance and expectation; however, the control group was far superior to the brain-injured subjects in number of problems completed. In comparing recently brain-injured subjects with other brain-injured subjects, it was found that the recently brain-injured group was unrealistic in their aspirations and also less adequately adjusted than either the other brain-injured group or the control group.

Caston, Richard J.

1978 A New Global Index for Occupational Statuses. Paper presented at the Annual Meetings of the American Sociological Association, San Francisco, Calif., September.

Caston argues that the use of Duncan's SEI as an index for occupational status is methodologically appropriate but it tends to produce avoidable conceptual confusion. He has proposed a new procedure for examining overall occupational statuses that employs indicators of the remunerative return of an occupation (in the form of salary, wages, and net self-employment income), its level of "prestige," and the required level of skills and training. In this procedure the traditional SEI educational measure is replaced by the DOT's SVP and GED scales.

Coburn, David

1975 Job-worker incongruence: Consequences for health. *Journal of Health and Social Behavior* 16(June):198–212.

This paper examines the consequences for health of work that is perceived as excessively complex or excessively simple—job incongruence. An objective measure of incongruence was constructed by comparing the required GED for jobs (listed in the DOT) with the actual educational attainment of the respondent. The author indicates that this is a highly limited measure of job incongruence due primarily to the difficulty in equating respondents' jobs with those defined in the DOT. Results showed that excessively complex work is not disliked but is associated with lower mental and physical health. Overly simple work, in addition to being disliked, shows similar psychological but much less evident physical effects. Finally, perceived incongruence has a much larger effect on health than does objective incongruence.

Cooper, Jacqueline Fribush

1976 Comparative impact of the SCII and the Vocational Card Sort on career salience and career exploration of women. *Journal of Counseling Psychology* 23(July):348–352.

The effects of the Strong-Campbell Interest Inventory (SCII), the Vocational Card Sort (VCS), and an exercise designed to make respondents aware of myths and realities of women in the world of work, the Auxiliary Informative Material (AIM), were examined in relation to (1) the number and type of career options considered, (2) frequency and variety of information-seeking behaviors, (3) career salience, and (4) satisfaction with the career exploration experience. The VCS materials include 90 cards, each with a DOT job title and job description. Results indicate some differences in the impact of the SCII and the VCS on the dependent variables; the VCS was found to be more effective than the SCII in broadening career options and in increasing the frequency with which subjects read occupational information.

Although the AIM did not have these effects, it did increase the career salience of women.

Cullen, John B., and Shelley M. Novick
1979 The Davis-Moore Theory of Stratification: A further examination and extension. *American Journal of Sociology* 84(May):1424–1437.

Using data for 267 occupational positions, Cullen and Novick derive and test several propositions from the Davis-Moore functional theory of stratification. Seven characteristics from the third edition DOT were employed: the three worker function scores (complexity of an occupation's relationship to data, people, and things); a five-point scale of physical demands rating an occupation from sedentary to very heavy work; the job's context, measured by a three-point scale of whether the job is commonly performed inside, outside, or both; discomfort as a dichotomous variable, noting that the DOT identifies at least one unpleasant condition associated with the performance of the occupation (e.g., extremes of cold or heat); and the eight-point specific vocational preparation scale, used to operationalize training. The analysis involves regressing income and prestige on various positional characteristics. Required talent (the job's functional complexity), training (SVP), and perceived functional importance were found to increase both prestige and income significantly. One aspect of disagreeableness (physically demanding work) negatively affected prestige but not income. Another aspect (outside work) positively affected income. In general, the empirical evidence was found supportive of the Davis-Moore theory of stratification.

Dawis, Rene V., and Lloyd H. Lofquist
1974 The Minnesota Occupational Classification System (MOCS). Minneapolis: University of Minnesota, Department of Psychology, Worker Adjustment Project.

The Minnesota Occupational Classification System (MOCS) is a psychological taxonomy of work for an initial group of 337 occupational titles and alternate titles. The system draws on data and variables from the Department of Labor's occupational aptitude patterns, the University of Minnesota's occupational reinforcer-pattern clusters, Holland's occupational classification, and the DOT. Specifically, the MOCS uses the DOT's group arrangement of occupations, worker trait groups (interests, temperaments, and physical demands), and worker functions (level of involvement with data, people, and things).

Dawis, Rene V., and Lloyd H. Lofquist
1975 Toward a psychological taxonomy of work. *Journal of Vocational Behavior* 8(October):165–171.

On the basis of the theory of work adjustment, occupational aptitude patterns and occupational reinforcer pattern clusters are cross-classified to develop psychologically homogeneous groups of occupations (taxons). Information from other different and independently developed classification systems is embedded in the taxon matrix, including the third edition DOT's occupational groupings, worker traits, and worker functions. The validity of the approach is supported by the consistency and complementarity of the descriptive information in a given taxon derived from these different sources.

Daymont, Thomas N.
1980 Changes in black-white labor market opportunities. In Herbert S. Parnes, Gilbert Nestel, Thomas M. Chirikos, Thomas N. Daymont, Frank L. Mott, Donald O. Parsons & Associates, eds., *From Middle to the Later Years: Longitudinal Studies of the Pre-Retirement and Post-Retirement Experiences of Men*. Boston: MIT Press.

This study examined changes in the relative employment opportunities of older black men between 1966 and 1976. The third edition DOT's GED variable was used as a measure of education in the author's analyses. In terms of employment security and earnings the relative opportunities of blacks were quite sensitive to fluctuations in economic conditions, improving in good times and declining in bad. In general, however, the relative opportunities of blacks along both of these dimensions improved substantially during this period. The results also indicated that governmental efforts have had an impact but that racial equity has not been attained and that continued antidiscrimination efforts are in order.

Desmond, Richard E., and David J. Weiss
1973 Supervisor estimation of abilities required in jobs. *Journal of Vocational Behavior* 3(April):181–194.

The Minnesota Job Requirements Questionnaire (MJRQ), representing each of nine GATB-DOT worker aptitudes with five items, was developed and administered to supervisors of 11 selected jobs who rated the ability requirements of the job they supervised. These ratings were compared with expert ratings of the DOT and Occupational Ability Patterns (OAP's) derived from administration of the General Aptitude Test Battery. The authors point out that the DOT's worker trait groups are not rigorous methodologically and have not been tested in a predictive study, nor have reliability data been presented for the DOT ratings. The reliability and validity of the MJRQ ratings were examined and found sound. The OAP's derived from the MJRQ compared favorably with those derived from the DOT and GATB, showing promise for the parsimonious MJRQ approach in the development of OAP's.

Desmond, Richard E., and David J. Weiss
1975 Worker estimation of ability requirements of their jobs. *Journal of Vocational Behavior* 7(August):13–27.

A modified version of the Minnesota Job Requirements Questionnare (MJRQ), representing the GATB-DOT worker aptitudes, was used by workers in 11 selected jobs to rate the ability requirements of their jobs. The reliability of worker MJRQ ratings was comparable to that of supervisor ratings, and further examination showed construct validity for workers' ratings. Occupational Ability Patterns (OAP's) derived from worker MJRQ ratings compared favorably with OAP's derived from supervisor MJRQ ratings, from the DOT, and from the GATB. Differences among workers on variables such as satisfaction, age, and tenure did not significantly affect their MJRQ ratings.

Dewey, Cindy Rice
1974 Exploring interests: A non-sexist method. *Personnel and Guidance Journal* 52(January):311–315.

This paper describes the Non-Sexist Vocational Card Sort (NSVCS), a derivative of the Tyler Vocational Card Sort. Seventy-six gender-neutral occupational titles are presented on 3 × 5 cards with DOT job definitions coded according to Holland's six personality types. The subject is asked to sort the occupations into three groups: might choose, in question, and would not choose. In exploring the reasons for these decisions the subject can learn more about his or her vocational preferences.

Droege, Robert R., and John Hawk
1977 Development of a U.S. Employment Service interest inventory. *Journal of Employment Counseling* 14(June):65–71.

Research was conducted to develop an interest inventory corresponding to the interest areas in the third edition DOT (Vol. 2). An inventory of 307 occupational activity items was developed and administered to a sample of 1,115 subjects in a selected number of states. An analysis of the results proved unsuccessful in developing scales to measure the current 10 interest factors in the third edition DOT (Vol. 2); however, a factor analysis led to identification of readily interpretable interest factors similar in meaning and occupational coverage for men and women and broad enough to include the range of occupations in the economy. These interest factors will form the basis for the new interest inventory.

Dubnoff, S.
1978 Beyond Sex Typing: Capitalism, Patriarchy and the Growth of Female Employment 1940–1970. Paper presented at the Rockefeller Foundation Conference on Women, Work and Family, New York.

Changes in the sex composition of occupations between 1940 and 1970 were estimated, using the 295 detailed occupations of the 1960 census as a standard. The effect of median earnings and the third edition DOT variables of DATA, PEOPLE, THINGS, GED, SVP and temperaments items 3 (supervision) and 4 (autonomy) on change in the percentage of women in occupations was assessed. The results showed that as the degree of complexity and level of involvement with data, people, and things increased, the percentage of women in an occupation decreased. The GED and SVP were strongly and negatively related to changes in the percentage of women in an occupation. The relative growth in the percentage of women was likely to be high in occupations in which supervision was high and low in occupations requiring worker autonomy. Finally, occupations with higher earnings showed less growth in the percentage of women employed. By virtually every measure considered, the percentage of women increased in occupations that were considered less desirable.

Dubnoff, S.
1978 Inter-Occupational Shifts and Changes in the Quality of Work in the American Economy, 1900–1970. Paper presented at the Labor Studies Section of the Society for the Study of Social Problems, San Francisco, Calif.

Census data for detailed occupations in each year between 1900 and 1970 and Temme's weighted estimates of the DOT's scores for DATA, PEOPLE, and THINGS, SVP, and GED for the 295 detailed occupations in the 1960 Census were used to determine the shifts in distribution of workers across relevant categories of occupational characteristics, not occupations. With the exception of the people and GED scores, the scores indicated a trend toward both a lessening of the complexity of work and a decrease in the amount of required training time. The two exceptions, GED and PEOPLE, are both biased against manual labor and merely reflect the transition from manual to nonmanual labor. Within the nonmanual group, women fared far worse than men on all measures. In fact, they were the only group to show a net decline in required training time.

Dumas, Neil S., and John E. Muthard
1971 Job analysis method for health-related professions: A pilot study of physical therapists. *Journal of Applied Psychology* 55(October):458–465.

A method for analyzing work of health personnel was devised and applied in a physical therapy service. Procedures for developing the special language for describing the tasks performed by physical therapists and methods for training observers to prepare sequential reports of the ongoing work of staff are presented. In encoding the "action" part of the task the authors used a modified version of the DOT's DATA, PEOPLE, and THINGS variables. Results indicated that observers could reliably report the detailed characteristics of the tasks in a physical therapy service over an extended period of time.

Eckaus, R. S.
1964 Economic criteria for education and training. *Review of Economics and Statistics* 46(May):181–190.

Eckaus criticizes the use of rate of return criteria for determining the economic significance of education and suggests, as an alternative approach, the direct computation of a job's educational requirements. The third edition DOT's SVP and GED scales were used to compute the educational requirements of census occupations. Eckaus converted these scales into year equivalents and then estimated the requirements for the census occupations. The results are presented in tabular form. Finally, the application of this approach to education and manpower planning is discussed. Eckaus' conversion of the two training time scales to year equivalents has since been adopted by a number of researchers.

Ekpo-Ufot, Abel
1976 Self perceived abilities relevant in the task (SPART): A potential predictor of labor turnover in an industrial work setting. *Personnel Psychology* 29(Autumn):405–416.

It has been suggested that workers' self-perceptions of their task-relevant abilities would predict their tendencies to quit their jobs. This paper describes the development and implementation of a SPART (self-perception of abilities relevant to the task) inventory for the job of auto assembler. The third edition DOT and the *Estimates of Worker Trait Requirements for 4,000 Jobs* were used as a source of worker aptitude requirements in formulating the inventory. Support was found for the reliability and construct validity of SPART; SPART was also somewhat predictive of job turnover. The author suggests further work to improve the instrument and discusses its possible applications.

Fine, Sidney A.
1955 A structure of worker functions. *Personnel and Guidance Journal* 34(October):66–73.

A structure of 26 worker functions, developed by the U.S. Employment Service and later incorporated into the third edition DOT, is described. A brief discussion of the structure and definitions of these functions is followed by a discussion of their reliability and their application. Fine suggests that they may be a useful research device in connection with job analysis, the study of criterion dimensionality, job classification, worker classification, performance evaluation, and the study of job satisfaction.

Fine, Sidney A.
1957 A reexamination of 'transferability of skills'—Part II. *Monthly Labor Review* (August):938–948.

The first half of this article examined some of the difficulties behind the assumptions about transferability of skills. This part explores a systematic approach to transferability based on the Functional Occupational Classification Project (which was later incorporated, in part, into the third edition DOT). Fine outlines the classification system and describes how the work performed components (worker functions—level of involvement with data, people, and things; work fields; and materials, products, subject matter, and services) can be organized to generate 5 orders of job similarity. The author suggests that depending on the training time required (low, medium, or high), for certain orders of similarity, transferability is feasible and practical. He then suggests practical applications of his model: to determine, in the case of unemployment insurance applicants, which jobs are "suitable" to skills they acquired on previous jobs; to counsel workers who must change jobs because of a handicap, age, or technological change; to determine how and where surplus skills in certain labor market areas can best be absorbed by other industries; to prepare for civilian defense; and to plan vocational training programs of the widest practical application in industry.

Fine, Sidney A.
1957 USES occupational classification and Minnesota occupational rating scales. *Journal of Counseling Psychology* 4:218–223.

An effort was made to determine whether the Minnesota occupational rating scales (MORS) of seven common ability areas and the U.S. Employment Service (USES) Functional Occupational Classification Project's (FOCP) worker trait and work performed dimensions serve the same purpose. Four experienced occupational analysts were provided with FOCP data for 37 of the MORS jobs and were asked to determine the MORS values for each job. The results indicated that the relatively gross data on worker traits and work performed components do have discriminatory value. Each of the two FOCP groups of data provided a basis for arriving at judgments about job requirements consistent with those arrived at by the MORS. Furthermore, the two sets of data—traits and work performed—combined were more predictive than either of them taken separately.

Fine, Sidney A.
1958 Matching job requirements and worker qualifications. *Personnel* 34(May):52–58.

Following a brief account of how the *Estimates of Worker Trait Requirements for 4,000 Jobs as Defined in the Dictionary of Occupational Titles* came to be published, Fine outlines the content and structure of the publication. He emphasizes that the DOT job definitions and worker trait requirements should be used as reference points and that when they are considering a specific position, personnel staffs should check any variation from the DOT definitions and alter the worker trait evaluations accordingly. In closing, a number of practical uses of *Estimates of Worker Trait Requirements for 4,000 Jobs* outside the Employment Service are considered, including its use as an aid in determining recruitment policies, which can contribute to worker morale by using the skills and knowledge of workers effectively.

Fine, Sidney A.
1968 *The 1965 Third Edition of the Dictionary of Occupational Titles—Content, Contrasts, and Critique*. Kalamazoo, Mich.: W. E. Upjohn Institute for Employment Research.

The content and organization of the third edition DOT are described and compared with previous editions. Fine suggests six improvements that could be made in the publication: (1) Replace the term "professional," a status-oriented title for the first major occupational group, with more descriptive, content-oriented titles (e.g., artistic, scientific). (2) Convert to a nine-digit code to meet the needs of education curricula (significantly different from the nine-digit code in the fourth edition). (3) Provide as a DOT supplement a short, easy-to-use manual for classifying workers' experience and defining worker traits. (4) Adopt an encyclopedic rather than dictionary format. Job definition entries should be listed by type of work instead of alphabetically (a suggestion that has been incorporated into the fourth edition). (5) Provide a separate volume of jobs and titles by industry group or distinguish between base and undefined titles by using varied typefaces (the latter suggestion has also been incorporated into the fourth edition). (6) Include a 5- or 10-page selected bibliography of DOT uses in research to assist future investigations.

Fine, Sidney A.
1968 The use of the *Dictionary of Occupational Titles* as a source of estimates of educational and training requirements. *Journal of Human Resources* 3(Summer):363–375.

Fine explains the supplementary data of the third edition DOT "as completely as possible so that they can be used [in research] . . . with a maximum of insight and flexibility." The concept of "requirements" (educational and training) is discussed, and explanations of the GED and SVP scales follow. He describes the estimating procedure that produced these scales and comments on the use and interpretation of the estimates. Finally, the author explains the DOT's occupational code system.

Fine, Sidney A., and Carl A. Heinz
1957 The estimates of worker trait requirements for 4,000 jobs. *Personnel and Guidance Journal* 36(November):168–174.

Following a brief account of the historical factors that led to the publication of *Estimates of Worker Trait Requirements for 4,000 Jobs as Defined in the Dictionary of Occupational Titles*, Fine outlines the content and structure of the document. The rating methods and reliability of the scales are examined and found to be sound. The significance and general limitations of the data are reviewed. In closing, Fine discusses possible uses of the publication in the Employment Service and as a source of job specifications for employers, of occupational information for vocational and personnel counselors, and of guidance for individual workers.

Fine, Sidney A., and Carl A. Heinz
1958 The functional occupational classification structure. *Personnel and Guidance Journal* 37(November):180–192.

The Functional Occupational Classification Structure (FOCS), a system of three-part, nine-digit codes, is described in detail. One part (three digits) classifies what workers do and reflects worker traits; a second classifies the work that gets done, that is, technologies; a third classifies materials, products, subject matter, and services, or what the jobs are mainly about. The aptitudes, interests, temperaments, physical demands, working conditions, training times, and industry associated with 4,000 job titles have been analyzed, and in searching for groupings with the optimum integration of worker trait information it was found that worker functions (level of involvement with data, people, and things) provided the best sort. The authors suggest several structural variations of the classification system, discuss possible applications, and outline areas of future study. Much of the FOCS has been used in the third and fourth editions of the DOT.

Gaertner, Gregory
1976 The intergenerational transmission of job complexity in horizontal divisions of the occupational structure. In James A. Davis, ed., *Studies of Social Change Since 1948*. Volume 2. Chicago: University of Chicago, National Opinion Research Center.

This paper explores the extent to which job complexity plays a part in the stratification of occupations. Results indicate (1) that the various sorts of job complexity for fathers are differentially but generally associated with the corresponding complexity of children's jobs, (2) that industry/situs groupings seem to have distinctive profiles of the various sorts of job complexity, and (3) that the effect of parental job complexity on child job complexity varies by importance of that trait in the industry in which the child's occupation is found. Job complexity was assessed using the DATA, PEOPLE, and THINGS scales of the third edition DOT.

Gottfredson, Gary D.
1977 Career stability and redirection in adulthood. *Journal of Applied Psychology* 62(August):436–445.

Age trends in the degree of career stability and change over a 5-year period were examined for a large sample of men and women workers. Data on current occupation (in 1970) and occupation 5 years earlier were collected by the U.S. Census Bureau and reorganized for this study using Holland's occupational classification. In addition, the third edition DOT's GED ratings were assigned to each occupation. Career stability increased with age for both sexes, and age differences persisted even when the analyses were restricted to occupation changers or socioeconomically mobile workers. People initially employed in "consistent" occupations (as defined by Holland's theory) were more stable than those initially employed in "inconsistent" occupations. Some kinds of midcareer redirection were more common than others.

Gottfredson, Gary D., and Denise C. Daiger
1977 Using a classification of occupations to describe age, sex and time differences in employment patterns. *Journal of Vocational Behavior* 10(April):121–138.

Employment data from the 1960 and 1970 censuses were organized using Holland's occupational classification to examine age, sex, and level of differences in employment and to detect changes over the 10-year period. Data were organized in terms of both kind and level of work, as measured by the third edition DOT's GED variable. The results form a systematic psychological description of the work force and its changing nature that can be communicated to people planning their careers, personnel workers and counselors, and government agencies and planners. For instance, a preliminary analysis revealed that "realistic" work (in Holland's definition) is becoming relatively less common and the sex composition of the occupational categories may be changing.

Gottfredson, Gary D., and Daniel J. Lipstein
1975 Using personal characteristics to predict parolee and probationer employment stability. *Journal of Applied Psychology* 60(October):644–648.

Predictors of employment stability were investigated for male parolees and probationers. Moderate significant correlations were found between stability (inferred from job referral records) and occupational consistency, job skill (defined by the DOT's GED scale), socialization, prior job tenure, incarcerations, auto theft, and a base expectancy measure. However, no significant correlations between employment stability and parole agent ratings were found.

Gottfredson, Gary D., John L. Holland, and Linda S. Gottfredson
1975 The relation of vocational aspiration and assessments to employment reality. *Journal of Vocational Behavior* 7(August):135–148.

The occupations of men and women detailed in the 1970 census were coded according to Holland's classification scheme. Those occupations not listed in the classification were coded by translating the third edition DOT code into Holland's categories following Viernstein's (1972) procedure. An occupation's level was defined as the GED level listed in the third edition DOT. Survey data about people's vocational aspirations and the results of vocational assessments made with and without norms for men and women at two educational levels were also coded according to Holland's classification. Results indicated that kinds of employment differ greatly for different educational levels and between the sexes. The use of sex-based interest inventory norms seemed unrealistic because they created distributions that diverged greatly from the distribution of actual employment. Some implications of the congruence between kinds of people and their employment are discussed for vocational guidance, test development, and career development research and theory.

Gottfredson, Linda S.
1978 *The Construct Validity of Holland's Occupational Classification in Terms of Prestige, Census, Department of Labor and Other Classification Systems.* Report No. NIE-400-77-0019. Baltimore, Md.: Center for Social Organization of Schools, The Johns Hopkins University.

Holland's six-category typology was examined in relation to the activities and requirements presented in the DOT (involvement with data, people, and things, GED level, and SVP) and to several other occupational classification systems. Comparisons of the classifications indicated that Holland's typology has considerable validity for describing work activities, general training requirements, and rewards, particularly when it is supplemented by a measure of occupational level. Results also showed that prestige, GED, SVP, involvement with data, and self-direction were all highly correlated and reflected level of work. Involvement with people was positively correlated and involvement with things negatively correlated with prestige.

Hartog, Joop
1977 On the multicapability theory of income distribution. *European Economic Review* 10(November):157–171.

This paper presents the "multicapable theory of income distribution," an attempt to describe a number of labor market phenomena by decomposing labor services into those arising from a number of different capabilities. Job wage rates are explained by prices of capabilities and the shape of the income distribution from assumptions on the distribution of capabilities and on labor supply behavior. Empirical support for the theory is also outlined, using U.S. Census income data matched with third edition DOT aptitude requirements for 1949, 1959, and 1969.

Hauser, Robert M., and David L. Featherman, eds.
1977 *The Process of Stratification: Trends and Analyses*. New York: Academic Press.

In Appendix B the *Dictionary of Occupational Titles* is recommended as a tool in coding occupations and industries into detailed 1970 Census categories. The DOT often lists several titles for one job, and coders are referred to the DOT when a job title cannot be found in the U.S. Census *Alphabetical Index of Industries and Occupations*. The definitions are also a great help in clarifying the activities and duties associated with a particular job so that it can be more accurately classified.

Hecht, Alfred R., and Lynn H. Willett
1974 Using a data bank for local career program planning and counseling. *Educational Technology* 14(April):33–36.

Morraine Valley Community College is developing a data bank for systematically gathering, reporting, and updating community socioeconomic data for occupational program planning and counseling. This computerized bank includes data on firm charcteristics, paraprofessional and technical job titles, and job functions for selected job titles. Both the third edition DOT and SIC titles are used.

Hemmens, George C., Edward M. Bergman, and Robert M. Moroney
1978 The practitioner's view of social planning. *Journal of the American Institute of Planners* 44(April):181–192.

This article reports on a study of recent graduates of planning and public policy schools who consider social policy planning to be their primary professional practice interest. Information from job incumbents on the job tasks performed and skills used on the job (coded according to the third edition DOT's worker function and GED scales) suggests that skill needs on the job are somewhat different from the skill training received in the professional schools. An examination of the fit between their education and their professional experience shows that these planners found their training lacking in communications skills and an understanding of the context of practice.

Hurt, David J., and Michael C. Holen
1976 Work values in vocational interest exploration. *Journal of Vocational Behavior* 8(February):89–93.

Data on Kuder Preference Record–Vocational scores, expressed vocational interest, and work values of 42 ninth graders were converted to comparable bases using Holland's environmental model. This was done using Viernstein's (1972) procedure, in which Holland's coding was adopted for all occupations listed in the third edition DOT. Work values was established as a significant, independently explanatory variable. The demonstrated utility of work values coupled with the commonality of expressed and inventoried interest suggest using work values to facilitate decision making with the vocationally decided, omitting the use of interest inventories.

Johnson, William F., Thomas A. Korn, and Dennis J. Dunn
1975 Comparing three methods of presenting occupational information. *Vocational Guidance Quarterly* 24(September):62–66.

The purpose of this study was to demonstrate a methodology for local development of slide-tape materials on occupational information materials and to determine whether the slide-tape presentation was a more effective means of conveying this information than printed or oral presentations. The occupational information was developed according to the *Handbook for Analyzing Jobs*, supplemented by the DOT and the *Occupational Outlook Handbook*. It was found that the slide-tape mode was the most effective way to present occupational information to the participants, who were all part of an atypical vocational counseling target group.

Jones, Jean J., and Thomas A. DeCoths
1969 Job analysis: National survey findings. *Personnel Journal* 48(October):805–809.

This paper reports the results of a nationwide survey of current uses, methods, and practices of job analysis. First, there is widespread dissatisfaction with present job analysis programs because of a lack of standardized, quantifiable techniques for gathering, recording, and presenting job information and limited use of EDP. Second, most job analysis programs are characterized by relatively little emphasis on job variables involved with human relations. Third, owing to the rapidly growing work force, the current emphasis on upgrading the unemployed and underemployed, and the impact of technological change on the nature of work, the traditional techniques of job analysis may no longer be adequate to meet the needs of the economy. The third edition DOT is cited as containing variables useful in job analysis schemes.

Jusenius, Carol L.
1977 The influence of work experience, skill requirement, and occupational segregation on women's earnings. *Journal of Economics and Business* 29(Winter):107–115.

Two competing explanations of the causes of the male-female wage differential are examined: (1) women typically have fewer years of work experience than men, and (2) occupational segregation has resulted in the overcrowding of women into a relatively small number of occupations. In her wage equations, Jusenius controls for the skill required by an occupation by using a modified version of the third edition DOT's SVP scale, making it possible to test the additional hypothesis that work experience is an effective way of accumulating human capital in only some occupations, the relatively high-skill occupations. It was found that both work experience and occupational segregation are critical determinants of women's wage position, the relative importance of each depending on the skill level of the occupation. Wage differentials in low-skill occupations are accounted for primarily by occupational segregation, while in the high-skill category, women are most disadvantaged by the amount of work experience.

Kalleberg, Arne L., and Larry J. Griffin
1978 Positional sources of inequality in job satisfaction. *Sociology of Work and Occupations* 5(November):371–401.

This paper attempts to conceptualize and assess that portion of the variation in job satisfaction that is generated by differential positions in the social and technical division of labor. Within each class, occupational position was determined using the U.S. Census codes, Duncan's (1961) SEI scores, and five scores taken from the third edition DOT (DATA, PEOPLE, and THINGS, GED, and SVP). Results indicated that working-class jobs are less satisfying because their incumbents obtain less financial and intrinsic job rewards than do workers in other classes.

Kalleberg, Arne L., and Paula M. Hudis
1979 Wage change in the late career: A model for the outcomes of job sequences. *Social Science Research* 8(March):16–40.

A model for the outcomes of job sequences is used to estimate the effects on wage change of a number of personal resources (e.g., age, training, education, and health) and measures of opportunity structure (public versus private employment, unemployment rates, geographic area, the DOT's SVP measure, etc.). The roles of these factors for black versus white men and for various patterns of labor market behavior are assessed. For men in their late careers it was found that SVP had a significant effect on wage change in general, and most specifically for white men who did not change occupations or employers. Education generally had a stronger effect on wage change for whites, while training had a stronger effect on career advancement for blacks.

Kalleberg, Arne L., and Aage B. Sorenson
1973 The measurement of the effects of overtraining on job attitudes. *Sociological Methods and Research* 2(November):215–238.

This paper presents various models for measuring the effect of being overtrained; overtraining refers to a discrepancy between a person's training and the educational requirements of his or her job. The GED scale from the third edition

DOT was used as a measure of a job's educational requirement. The various assumptions regarding the effects of overtraining that are embodied in the different models are discussed as well as the difficulties with using such variables as GED and years of education. Kalleberg found that a simple additive model describes the effect of overtraining on job satisfaction, while a model adding interaction terms is needed to account for the effect of overtraining on job development.

Kohn, Melvin L.
1969 *Class and Conformity: A Study in Values.* Chicago: University of Chicago Press.

The relationship of class to parental values and, more generally, to orientation is examined. The author first argues that class is pervasively related to men's valuation of self-direction or conformity. He then argues that class differences in parental valuation of self-direction or conformity provide a necessary key for understanding class differences in parental behavior. Finally, the author attempts to interpret why class is related to values and orientation. Many of the studies conducted by Kohn and his colleagues use a measure of substantive complexity modeled closely after the DATA, PEOPLE, and THINGS scales of the third edition DOT. Kohn describes his scales as differing from those of the DOT only in a more careful assessment of supervision, greater flexibility in ratings of multiple job functions, more stringent ratings of data and less stringent ratings of things, and a slightly different rating of people for teachers and consultants. These differences, he points out, are minor.

Kohn, Melvin L., and Carmi Schooler
1969 Class, occupation and orientation. *American Sociological Review* 34(October):659–678.

Interviews were conducted with 3,100 men, representative of all men in the United States employed in civilian occupations. About half the questions were directed to job, occupation, and career, and the remainder to background information, values, and orientation. Several questions dealt with the nature of the worker's involvement with data, people, and things, a classification scheme closely modeled after the DOT. Kohn and Schooler found that the worker functions were somewhat related to all aspects of values and orientation studied. Working with data or people was associated with valuing self-direction and holding a consonant orientation, while working with things was associated with having conformist values and orientation. It is interesting that the specifics of the men's work with data, people, and things—the *kinds* of data, tools, or people they worked with—were found to be relatively unimportant. The relationships between other occupational characteristics and values and orientations were also examined and discussed.

Kohn, Melvin L., and Carmi Schooler
1973 Occupational experience and psychological functioning: An assessment of reciprocal effects. *American Sociological Review* 38(February):97–118.

The central issue of this paper is whether adult occupational experiences of men affect or merely reflect their psychological functioning. Twelve occupational conditions defining the structural imperatives of a job were isolated. Kohn and Schooler argue that the relationships between occupational conditions and psychological functioning result from a continuing interplay between job and man, in which the effects of job on man are far from trivial. An assessment of the reciprocal effects of the substantive complexity of the work and several facets of psychological functioning indicates that substantive complexity has a decidedly greater impact on psychological functioning than the reverse. The third edition DOT's DATA, PEOPLE, and THINGS scales were used as a source of external validation for the authors' index of substantive complexity. These scales were also used in assessing the complexity of past jobs.

Kolstad, Andrew J.
1976 Sources of Occupational Prestige: A Study of Public Opinion. Unpublished dissertation. Stanford, Calif.: The Laboratory for Social Research, Stanford University.

Using U.S. Census data and the third edition DOT's scales for GED, SVP, PEOPLE, working conditions, ability, and temperaments, Kolstad attempted to determine what attributes of work roles in addition to earnings influence public opinion ratings of various occupations and how the magnitude of these influences varies across the general public by socioeconomic position and other social factors. Previous research has examined the dependence of public opinion on earnings, educational attainments, and other census characteristics of only the male workers in each occupation. Including data on female workers changed the earlier findings in that the racial composition effect became insignificant and the female composition effect became positive and significant.

Kolstad, Andrew
1977 Sex Composition and the Social Standing of Occupations. Paper presented at the Annual Meetings of the American Sociological Association, Chicago, Ill., September.

Occupations held mainly by men and those held mainly by women were compared using 1963–1965 NORC surveys of the social standing of occupational titles matched to the 1960 Census occupational classification, census statistics on both male and female workers, and DOT data on GED, SVP, physical demands, and relationship to people. The percentage female was found to be negatively correlated with earnings, occupational prestige, GED, and SVP. However, after adjusting for the effects of earnings and educational requirements on occupational prestige, work in occupations held mainly by women was significantly more positively evaluated than work in occupations held mainly by men.

Kopstein, Felix F.
1977 Task specifications and diagnosis in educational technology. *Educational Technology* 17(October):26–30.

Two scientific approaches to educational technology, a prediction and a control paradigm, are discussed. The author describes a method for constructing and verifying the accuracy of task specifications. An illustration from an occupational assessment system based on work sample techniques is presented, and the third edition DOT is cited as a useful source of requirements needed to construct these tasks. Uses of task specifications are suggested, including sensitive detailed diagnoses of performance errors.

Landrum, John H., and C. Todd Strohmenger
1979 A basic in education and agency career counseling: The new DOT. *Vocational Guidance Quarterly* 27(June):291–300.

The purpose of this article is to describe objectively and encourage strongly the use of the fourth edition DOT by counselors in education and community agency settings. The authors feel that many career counselors may find that by spending additional time investigating the DOT and integrating it with closely related materials and other career information courses, they can put all of these tools to work more efficiently for their clients and themselves.

Lindholm, Byron W., and John Touliatos
1976 Comparison of children in regular and special education classes on the Behavior Problem Checklist. *Psychological Reports* 38(April):451–458.

To establish the validity of the Behavior Problem Checklist, 1,999 white and 192 Mexican-American children in regular classes and 192 white and 17 Mexican-American children in special education classes were tested. Social class of the subjects was defined in terms of the occupation of the head of the child's household, derived from the DOT classification. Teachers provided general information and checklist ratings. All four factors of the checklist were found to be valid. In addition, there was some indication that white subjects in regular classes were more consistent from social class to social class than white subjects in special education classes.

Lindholm, Byron W., John Touliatos, and Amy Rich
1978 Racial differences in behavior disorders of children. *Journal of School Psychology* 16(Spring):42–48.

This study compared black and white children on the Behavior Problem Checklist. Data were obtained from school records and from teachers. Social class was defined in terms of father's employment according to the classification system of the third edition DOT. Class I included professional and technical workers, managers, officials, and proprietors; class II was composed of clerical and sales workers; class III was composed of craftsmen and operatives; and class IV was composed of laborers, service workers, and the unemployed. Blacks were judged to have a greater frequency of behavior disorders than whites, and the lower classes had more problems than the higher classes. Differences between social classes were greater for blacks than for whites. Other interactions centering on race are discussed.

Lucas, Robert E. B.
1974 The distribution of job characteristics. *Review of Economics and Statistics* 56(November):530–540.

This paper presents a cross-sectional analysis of the distribution across population classes (black-white, male-female) of workers' job characteristics. Information on job characteristics (aptitudes, training time, temperaments, physical demands, relationship to people, and working conditions) was taken from the DOT, and data on individuals were supplied by the Survey of Economic Opportunity. Lucas found that controlling for sex, negative job characteristics were considerably more frequent among blacks. Negative working conditions and physical demands were in general less common among female workers but were almost as frequent for black women as for white men. Results also indicated that women hold jobs requiring far less specific vocational preparation (SVP) and that there is a tendency toward "improvement" of job characteristics with age only for white men.

Lucas, Robert E.B.
1977 Hedonic wage equations and psychic wages in the returns to schooling. *American Economic Review* (September):549–558.

The study's objective was to discover how individuals' wages vary, all other things being equal, with the quality of working life by inserting job characteristic variables into a wage equation that also included personal data. Lucas first considers the problems of choice when employers and employees face parametric wages, in a situation in which both work and workers vary in quality. By using the *Survey of Economic Opportunity* and the DOT data on job characteristics, the previously formulated hedonic wage equation is estimated. Results show that workers receive higher money wages in compensation for jobs involving repetitive routines and obnoxious physical work environments and for those jobs requiring higher levels of SVP and GED . Finally, results on psychic wages as a return to schooling indicate a considerable downward bias from estimating such returns in terms of monetary rewards alone.

McCloud, Barbara K., Marlys M. Mitchell, and Gilbert G. Ragland
1976 Content analysis of basal reading texts for normal and retarded children. *Journal of Special Education* 10(Fall):259–264.

In an effort to discover whether there are differences between the content of basal stories written for normal children and those written for or widely used with educable mentally retarded (EMR) children, achievement imagery, dependent behaviors, and occupational roles of the characters were examined. Occupational roles of the story characters were determined using the nine categories of the third edition DOT. No significant differences in frequency of occupations were found; there was, however, an indication that readers for retarded children more often describe occupations in the professional, technical, and managerial classification. The authors discuss the need for exposure to realistic vocational choices for EMR children.

McKinlay, Bruce

1976 *Characteristics of Jobs That are Considered Common: Review of Literature and Research*. Information Series No. 102. Columbus: Ohio State University, Center for Vocational Education.

This paper reviews the occupational literature in an attempt to identify or infer what it contributes to an understanding of occupational similarities and occupational transfers. The third edition DOT is described in detail in the author's discussion of systems of job analysis, worker traits, and socioeconomic classifications.

McLaughlin, Steven D.

1978 Sex differences in the determinants of occupational status. *Sociology of Work and Occupations* 5(February):5–30.

This paper examines the equivalence of occupational status as it is assigned to occupations held mainly by men and those held mainly by women. The third edition DOT furnished descriptive data on 331 occupations drawn from the 1970 detailed census occupational classification. The nature of the occupational task; the DATA, PEOPLE, and THINGS variables; the aptitudes demanded of workers; and the required physical strength were examined. The author felt that the ordering of complexity levels for the DATA, PEOPLE, and THINGS variables was not clear enough to warrant the use of a 0–8 point rating scale. For his purposes, he trichotomized the DATA variable into a conceptually interval scale and dichotomized PEOPLE and THINGS variables to form the dummy variables representing the presence or absence of an occupational relationship. McLaughlin found that occupations dominated by women had an average status score lower than the occupations in which 75 percent of the workers were men, but occupations in the mixed category (50–75 percent) had the highest mean status value. The mix of status-relevant occupational characteristics that contributed to these scores was strikingly different for the three occupational categories.

Miller, Ann R.

1971 The federal inter-agency Committee on Occupational Classification: A progress report. Pp. 11–19 in *American Statistical Association 1971 Proceedings of the Business and Economics Statistics Section*. Washington, D.C.: American Statistical Association.

The paper provides a sampling of the activities of the Committee on Occupational Classification of the Office of Management and Budget, in connection with establishing a standard occupational classification system and a convertibility arrangement for the existing U.S. Census and DOT systems. Miller discusses the discrepancies between the two classification systems and describes the committee's work on cross-coding the 1960 Census occupational titles, the nine-digit DOT codes, and *Current Population Survey* returns. As an example of the advantages of being able to move from one system to another, data from the CPS-DOT coding project, summarizing the relationship between workers' educational attainment and the GED required of their occupations, are presented. Finally, Miller outlines the committee's work on a standard occupational classification system, presenting a draft for the professional occupations, a preliminary draft for clerical occupations, and a first experimental grouping for blue-collar workers.

Miller, Ann R.
1971 *Occupations of the Labor Force According to the Dictionary of Occupational Titles.* Statistical Evaluation Report No. 9. Washington, D.C.: Executive Office of the President, Office of Management and Budget.

Some results of an experimental project designed to obtain data on the relationship between the occupational classification systems of the DOT and that of the Census Bureau are presented. Since this is the first attempt to use the DOT as a classification tool for comprehensive labor force data, the primary emphasis of the report is on the data produced by applying the DOT system. The first section presents selected demographic characteristics of persons classified in the major DOT categories and the larger divisions and groups within these. Included is a cross tabulation, at the major group level, of data classified by both the Census Bureau and DOT occupational systems. In the second section, tabulations for certain internal characteristics of the DOT structure itself are presented. A preliminary analysis of distributions under the functional hierarchies developed by the Employment Service (level of involvement with data, people, and things), as they appear when they are applied to the labor force, is included.

Miller, Joanne, Carmi Schooler, Melvin L. Kohn, and Karen A. Miller
1979 Women and work: The psychological effects of occupational conditions. *American Journal of Sociology* 85(July):66–94.

The central issue of this paper is whether adult occupational experiences of women affect or merely reflect their psychological functioning. Several occupational conditions defining the structural imperatives of a job were examined, including a measure of substantive complexity modeled closely after the third edition DOT's DATA, PEOPLE, and THINGS scales. The authors found that job conditions that encourage self-direction are related to effective intellectual functioning and an open, flexible orientation to others, while those that constrain opportunities for self-direction are related to ineffective intellectual functioning and a rigid social orientation. Causal analysis demonstrates that job conditions not only correlate with but actually affect psychological functioning. For women, as for Kohn and Schooler's (1973) men, occupational conditions have a decided psychological impact.

Mortimer, Jeylan T.
1974 Patterns of intergenerational occupational movements: A smallest-space analysis. *American Journal of Sociology* 79(March):1278–1299.

When the smallest-space analysis technique was used to investigate the relationship between fathers' occupations and male college students' career choices, three dimensions of work were found to be relevant to the interpretation of the space: autonomy, rewards, and functional foci. The 129 occupational groups studied were classified according to the DOT's interest variables, and a determination was made as to whether the jobs were oriented primarily to people or to data and things. Examination of the data indicated a strong pattern of occupational inheritance. When sons did not inherit their father's occupations, they still tended to choose work offering their fathers' vocational experiences.

Mortimer, Jeylan T.
1976 Social class, work and the family: Some implications of the father's occupation for familial relationships and sons' career decisions. *Journal of Marriage and the Family* 38(May):241–256.

The effects of both vertical and nonvertical dimensions of father's work on family relations and vocational socialization are examined. Fathers' occupations were grouped into 12 categories: the professional groups were doctors, dentists, scientists, lawyers, teachers, and college professors; the business groups were classified as self-employed or not, and a distinction was made between people-oriented and technical (data-oriented or things-oriented) occupations on the basis of the third edition DOT interest ratings; artists and government employees were also categorized. Higher-income fathers were perceived as being closer to their sons and as being more powerful family figures, but the functional focus of work had no impact on parent-child relations. Closeness to father emerged as an important variable mediating the transmission of different occupational reward values, depending on the situs, prestige, and functional focus of the work. Further analysis revealed that the combination of a prestigious paternal role model and a close father-son relationship engenders the most occupationally differentiated vocational socialization.

Mortimer, Jeylan T., and Jon Lorence
1979 Work experience and occupational value socialization: A longitudinal study. *American Journal of Sociology* 84(May):1361–1385.

This research examines the effects of work experience on occupational reward values, which are of central importance in occupational choice, career development, and subjective responses to work. Whereas it is often assumed that occupational values remain fixed throughout the work history, a confirmatory factor analysis of data obtained from male college graduates over a 10-year period demonstrates that work autonomy and income influence intrinsic, people-oriented, and extrinsic values. To control for the effects of fathers' work on sons' values and content of occupations, the third edition DOT's scale for DATA was used to rate the complexity of father's work, and these data were considered in the analyses.

Neff, Walter S.
1970 Work and rehabilitation. *Journal of Rehabilitation* 36(September-October):16–22.

The author notes the close connection between issues of rehabilitation and of work and finds the current techniques of aptitude and ability assessment inadequate. Standardized vocational tests are unsuitable for clinical work because they are designed for use with normal populations and because they have poor predictive value. Neff feels that the DOT has not been especially useful in rehabilitation efforts because clients have at best made a marginal work adjustment and tend to represent the lowest rungs of the occupational ladder. The DOT is felt to be inadequate in these areas. The author discusses other rehabilitation techniques.

Newman, Jack, and Sidney A. Fine
1956 A note on Thorndike's Preference Blank for Psychologists. *American Psychologist* 11(July):334–336.

The authors demonstrate that the worker function and work performed components developed for the DOT produce results very similar to those obtained by Thorndike's Preference Blank for Psychologists. Thorndike's 119-item form was designed to assess the activity preferences of psychologists through an in-depth statistical analysis resulting in five independent activity clusters. Newman and Fine describe their functional occupational classification structure and suggest that it may be useful for this kind of analysis of other professions as well.

Newnan, Owen S., Robert K. Heaton, and Ralph A. W. Lehman
1978 Neuropsychological and MMPI correlates of patients' future employment characteristics. *Perceptual and Motor Skills* 46(April):635–642.

This study investigated the utility of neuropsychological test scores in predicting severe vocational variables. Patients who had received neuropsychological evaluations were recontacted and questioned about their employment over the previous 6 months. Those employed were asked about job stability, hours worked, and wages earned and were administered the Minnesota Job Requirements Questionnaire (an assessment of the nine DOT worker trait aptitude requirements). Patients' scores on the Halstead-Reitan Battery, the WAIS, and the MMPI were highly correlated with employment status, income, and skills required on the jobs held. The results suggest that these tests may have clinical utility in assessing patients' employment ability as well as the types of jobs for which they are suited.

Nuckols, Troy E., and Raymond Banducci
1974 Knowledge of occupations—Is it important in occupational choice? *Journal of Counseling Psychology* 21(May):191–195.

The knowledge that 684 high school senior boys had of selected occupations was examined in relation to academic achievement, social status, formulation of future plans, and personal experiences. Students rated 12 occupations in terms of selected DOT worker trait requirements (interests, aptitudes, GED, and SVP) needed for successful performance of a job and were asked to indicate when they did not know the required worker traits. All students, regardless of their academic achievement, social status, and formulation or nonformulation of future plans, had a greater knowledge of low-level occupations than of high-level occupations. Personal experiences were positively related to the knowledge that students had of occupations.

Otto, Luther B., Vaughn R. A. Call, and Kenneth I. Spenner
1979 *Design for a Study of Entry into Careers*. Boys Town, Neb.: Center for the Study of Youth Development.

This paper describes an ongoing program of research that is being conducted at the Boys Town Center for the Study of Youth Development, investigating the process by which individuals gain access to careers. Rather than focusing on a single phase of analysis, this research is organized around both structural and individual-level explanations of careers. Initial research involves the empirical construction of multidimensional career lines. For each career line, estimates of six work role features for each job point in the line were produced: earnings, employment stability, complexity of work, routinization, and closeness of supervision. The GED, SVP, abilities, temperaments, and working conditions measures of the third edition DOT were used in these estimates. The results of these analyses serve as major dependent variables for the second phase of the research program, which investigates how individuals gain access to careers.

Pratzner, F. C., and R. W. Stump
1977 Report on a Project to Study Occupational Change and Transferable Skills. Unpublished paper, Center for Vocational Education, Ohio State University.

The paper describes a project being conducted by the Center for Vocational Education, whose purpose is to explore the notion of transferable skills. In the first section, concerned with identifying the individual skills and abilities that are considered to be transferable from one occupation to another, systems of occupational classification and analysis are reviewed, including Miller's (1971b) work on the level of GED required for specific jobs and the DOT itself. The authors caution users of the DOT's GED information, questioning its reliability and validity. The second section seeks to identify ways in which occupational change could be studied. Several approaches to job analysis are described, three of which are employed in the DOT: worker traits, socioeconomic class, and work environment. The paper concludes with recommendations on how educational and training institutions are or could be developing individual capabilities in transferable skills.

Prediger, Dale J.
1976 World of Work Map for career exploration. *Vocational Guidance Quarterly* 24(March):198–208.

This article describes the development, characteristics, and use of the World of Work Map and the associated American College Testing Program Occupational Classification System (ACT-OCS). All third edition DOT occupations were used as primary units of analysis in developing the classification system of 6 job clusters, 25 job families, and 3 levels of required preparation. The classification is centered on two work task dimensions: people-things and data-ideas. These dimensions are similar to the DOT's worker functions; however, Prediger's analysis of the worker traits and worker functions reveals a strong negative correlation between data and ideas, indicating that these foci of work, treated as one variable in the DOT, are actually two distinct worker functions. The allocation of occupations to the three job preparation categories was based on the DOT's SVP ratings. The author describes how the map and ACT-OCS can provide persons at an early stage of career planning with an overview of the world of work and to help them identify personally relevant occupational options.

Remenyi, Andrew G., and Barry F. Fraser
1977 Effects of occupational information on occupational perceptions. *Journal of Vocational Behavior* 10(February):53–68.

Extending Osipow's (1962) study of the effects of occupational information on occupational perceptions, a sample of 173 subjects consisting of school students, university students, and teachers provided ratings on the semantic differential for each of nine jobs, in the absence and in the presence of occupational descriptions. These descriptions were taken from the DOT with some rewording and abbreviation. In general, the addition of occupational information to the occupational titles raised the subjects' ratings of the occupations. In addition, school students held more favorable job perceptions than university students and teachers.

Roomkin, Myron, and Gerald G. Somers
1974 The wage benefits of alternative sources of skill development. *Industrial and Labor Relations Review* 27(January):228–241.

Using questionnaire data supplied by employees of a machine tool company, the authors estimated the impact on wages of pre-employment training and related experience and compared these results with the wage effects of on-the-job training and internal mobility after employment. Prior employment experience in a similar job was the most common source of worker skills prior to present employment. A similar occupation was defined as one whose first two digits in the third edition DOT code matched those of the first job held at the company under study and was of the same general level of skill requirement (i.e., skilled, semiskilled, or unskilled). Roomkin and Somers conclude that the internal practices of job promotion and training made greater contributions to the earnings of most blue-collar workers than the skill and knowledge acquired by these workers before joining the firm studied.

Rosen, Stuart D., Darwin D. Hendel, David J. Weiss, Rene V. Dawis, and Lloyd H. Lofquist
1972 *Occupational Reinforcer Patterns.* Volume 2. Minneapolis: University of Minnesota, Department of Psychology, Vocational Psychology Research.

Occupational Reinforcer Patterns (ORP's) for 67 occupations are presented alphabetically, using third edition DOT titles (see Borgen et al., 1972). These additional ORP's are based on the combined Minnesota Job Description Questionnaire ratings of supervisors and/or employees. The ORP's for 12 occupational clusters, intercorrelations of the 148 ORP's, and a table listing occupations according to reinforcement scale value by scale are also presented.

Ruchlin, Hirsch S.
1971 Education as a labor market variable. *Industrial Relations* 10(October):287–303.

This study examined the role of education as a labor market variable by comparing employers' education requirements (EER) for particular jobs with the third edition DOT's GED and SVP ratings. Occupations from all major DOT categories were used except professional, managerial, and unskilled occupations. The authors used two different methods for converting GED ratings into equivalent years of schooling (see Berg (1970) and Eckhaus (1964) in this bibliography). Results showed that the average employers' estimates of educational requirements exceed the GED estimates for the clerical and sales groups and to a degree the service group, while the reverse was true for skilled and semiskilled occupations.

Ruchlin, Hirsch S.
1972 The credentializing role of education. *Education Forum* 36(March):327–334.

Ruchlin compared the third edition DOT's GED and SVP requirements with employers' estimates for 1,345 jobs. His methods for converting the two DOT scales into year equivalents were unspecified. Results indicated that employers' estimates exceeded the DOT estimates in the clerical and sales groups and to a degree in the service group, while the reverse was true for skilled and semiskilled occupations. Ruchlin interprets his results as supporting the credentializing and screening-out role of education requirements and discusses implications for public policy.

Rumberger, Russell W.
1980 The economic decline of college graduates: Fact or fallacy? *Journal of Human Resources* 15(Winter):99–113.

This study examined the economic position of college graduates, as measured by relative earnings, between 1969 and 1975 as well as the absolute occupational position of graduates, as measured by the degree of utilization of skills. The educational attainments of workers were compared with the third edition DOT's GED requirements for the jobs they held. Results indicated that in general, the earnings of college graduates did not decline in relation to high school graduates between 1969 and 1975. However, it was found that overeducation is widespread throughout the labor market, affecting high school as well as college graduates. The evidence suggests that the occupational position of college graduates relative to high school graduates declined, both absolutely and relatively, between 1969 and 1975.

Sainty, Geoffrey E.
1974 A validation of the worker trait groups in the DOT. *Journal of Vocational Behavior* 5(August):173–176.

An empirical validation of the 114 worker trait groups of the third edition DOT was performed by comparing the factor structure of the worker trait components of the

114 worker trait groups with the factor structure of a random sample of 800 of the 4,000 jobs used as the basis for the third edition DOT. Six factors were compared, and cosines between .8997 and .9657 were obtained on the matched factors.

Sattler, Jerome M., and Nancy E. Anderson
1973 The Peabody Picture Vocabulary Test, Stanford-Binet, and the Modified Stanford-Binet with normal and cerebral palsied preschool children. *Journal of Special Education* 7(Summer):119–123.

This study was designed to determine the validity of two tests of intelligence—the Peabody Picture Vocabulary Test (PPVT) and the Stanford-Binet Intelligence Scale Modified (SB Modified)—by comparing them with the standard Stanford-Binet Intelligence Scale (SB) in normal and cerebral palsied populations. The third edition DOT was used to determine the socioeconomic status of subjects. The significant correlations found between the PPVT and SB generally agree with those reported in the literature. Both seem to be useful instruments for assessing the intellectual ability of both normal and cerebral palsied preschool children. However, as often reported, socioeconomic status was positively correlated with IQ.

Schilling, R. S. F., A. D. Letal, S. L. Hui, G. J. Beck, J. B. Schoenberg, and A. Bouhuys
1977 Lung function, respiratory disease and smoking in families. *Amerian Journal of Epidemiology* 106(October):274–283.

Respiratory symptoms, disease, and lung function were studied in 376 families with 816 children. Socioeconomic class was determined by classifying the father's occupation into one of eight groups based on the third edition DOT. Socioeconomic class was not found to be a factor in offspring's illness, nor was parental smoking. There was no evidence that passive smoking affected either lung function or symptoms of adults, and no association between prevalence of self-reported cough and/or phlegm in parents and their children was found. However, there was a highly significant association between the prevalence of wheeze in parents and their younger children.

Scoville, James G.
1965 The development and relevance of U.S. occupational data. *Industrial and Labor Relations Review* 19(October):70–79.

Various types of occupational classification systems are examined, and the development of American occupational statistics is discussed. Scoville briefly outlines the development of the second edition DOT and describes the content and organization of the then forthcoming third edition, including the worker function data (level of involvement with data, people, and things). He points out that whereas the purpose of the first and second editions was to show the type of work done, the new system of the third edition intends to correlate worker orientations and job characteristics more easily and thoroughly. The author concludes with a critique of U.S. Census data, arguing that the data were not designed and are not useful to answer the questions about the kinds and nature of jobs in our economy, that the distribution of the detailed data among the census groups is weak and inconsistent, and that the basic detailed figures themselves are very weak.

Scoville, James G.
1965 Making occupational statistics more relevant. In *American Statistical Association, Proceedings of the Business and Economic Statistics Section.* Washington, D.C.: American Statistical Association.

The paper discusses U.S. Census data, the need for a more relevant conceptual framework, and the need for statistical improvement in occupational research. Scoville cites the DOT as "the only comprehensive attempt at describing job requirements or some aspects of job content for a large and diverse sample of jobs which has so far been published." However, he criticizes the worker trait groups and their use by the Employment Service as well as the functional job analysis system (relationship to data, people, and things).

Scoville, James G.
1966 Education and training requirements for occupations. *Review of Economics and Statistics* 48(November):387–394.

The study used data on GED and SVP requirements found in *Estimates of Worker Traits Requirements for 4,000 Jobs as Defined in the Dictionary of Occupational Titles.* These 4,000 jobs were drawn from the second edition DOT and then allocated among the 221 major occupational groups of the 1950 Census. The education and training data by occupation were presented, and the quality of the data was examined. In a large number of cases the median attainment did not match the estimated requirements, calling into question the basic data or the author's estimating procedure.

Scoville, James G.
1969 *Concepts and Measurements for Manpower and Occupational Analysis.* Washington, D.C.: Office of Manpower Research, U.S. Department of Labor.

Following a discussion of current uses of occupational data, the author reviews the current schemes of occupational classification and analysis and suggests reforms. In this section he describes the history and content of the third edition DOT in detail. He criticizes the DATA, PEOPLE, and THINGS scales, noting that the concept of responsibility is completely omitted and that the scheme does not reflect important interactions between the three components. He criticizes the GED scale for its lack of an accepted conversion to year equivalents and the SVP scale as being unclear in practical use. Scoville quotes employers' criticisms of the DOT as a useful set of job titles and definitions. The author presents an economic theory of jobs and concludes with summary recommendations for a system of occupational data collection.

Scoville, James G.
1969 *The Job Content of the U.S. Economy 1940–1970.* New York: McGraw-Hill.

This book describes an exploratory study of long-term changes in the job content of the American economy using census data for 1940–1960 and estimates for 1970. Scoville criticizes the census data and the DOT, particularly the DATA, PEOPLE, and THINGS scales, as being inadequate for the purposes of job analysis. Using a stepwise regression, he estimated the "market price" of the DOT's GED, numerical, spatial perception, and color discrimination abilities. The author also used the GED and SVP scales to assess changes in education requirements for job families. Finally, estimated GED and SVP requirements for selected census occupations are presented in Appendix 1 (originally published in 1966).

Seggar, John F., and Penny Wheeler
1973 World of work on TV: Ethnic and sex representation in TV drama. *Journal of Broadcasting* 17(Spring):201–214.

This study analyzed the portrayal of minorities on TV in 1971. The major purpose was to examine TV dramas and analyze the extent to which minorities were represented and to compare their portrayals with those of white Americans. The third edition DOT was used to classify characters' jobs. The following results were found: there was an overrepresentation of all groups in the professional and managerial fields; the labor market of television most closely resembles the actual labor market only in the field of farmers and farm managers; there was an underrepresentation of all groups in occupations with little prestige, except in the service area; and minorities, more so than American whites, were both concentrated in fields of personal service and more likely to suffer from stereotyped images.

Seybolt, John W., and Leopold Gruenfeld
1976 The discriminant validity of work alienation and work satisfaction measures. *Journal of Occupational Psychology* 49(December):193–202.

A sample of 1,700 county and municipal workers was divided into four major occupational categories according to the DOT. Operational measures of the attitudes of work alienation and work satisfaction were examined to determine if in fact they are separate attitudes or merely different terms for the same construct. The results revealed that the measures of the two attitudes are extremely similar. In fact, they appeared to be differentially related only to level of formal education, and this was true only for certain occupational levels.

Shartle, Carroll L.
1964 Occupational analysis, worker characteristics, and occupational classification systems. Pp. 285–309 in H. Borow, ed., *Man in a World at Work.* Boston: Houghton Mifflin Co.

In his review of methods of occupational analysis, Shartle mentions the Employment Service job analysis used in developing the DOT as the largest program of its kind. He describes the DOT as a classification system based on job content as well as worker characteristics, which also reflects socioeconomic levels as part of its structure. The structure of the third edition DOT is examined at length as an example of occupational classification. The article concludes with a brief discussion of the limitations of functional occupational classification systems: certain employee entrance standards may reflect unseen yet actual restrictive requirements of race, age, sex, and social conformity; job requirements are flexible and relative to labor supply and geographic location; rapid technological changes may quickly render published standards obsolete; and finally, occupational classification systems based on worker characteristics often overemphasize entrance requirements.

Sjogren, Douglas
1977 *Occupationally-Transferable Skills and Characteristics: Review of Literature and Research.* Information Series No. 105. Columbus: Ohio State University, Center for Vocational Education.

This paper synthesizes research and literature on the nature of occupationally transferable skills, specifically to identify skills that seem to be highly transferable, in the sense of being general to a number of occupations. The author speculates about characteristics of skills that are generalizable or transferable. Some implications regarding educational programs, hiring and employment search practices, and research are drawn. The author relied most heavily on the third edition DOT's worker trait and worker function scales in his analyses.

Snyder, David, and Paula M. Hudis
1979 The sex differential in earnings: A further reappraisal. *Industrial and Labor Relations Review* 32(April):378–374.

In this review of an earlier article, Snyder and Hudis examine the association between occupational sex composition and gender-specific earnings. Using 1960 and 1970 Census data, the authors regress earnings on percentage female, median education, and several additional occupational characteristics. The third edition DOT variable SVP (specific vocational preparation) is employed to measure the number of years of training required to develop the skills needed for average performance in a given occupation. The SVP score discriminates at least roughly among specific training times necessary for incumbency in an occupation and is considered conceptually distinct from the "general" skills implicit in the median education measure. The analysis shows that gender composition of occupations is an important determinant of women's lower earnings but is less important than sex differences in economic returns to education, training, etc.

Snyder, David, Mark D. Hayward, and Paula M. Hudis
1978 The location of change in sexual structure of occupations, 1950–1970: Insights from labor market segmentation theory. *American Journal of Sociology* 84(November):706–717.

To investigate changes in the sex composition of occupations between 1950 and 1970, the detailed U.S. Census occupations for 1950, 1960, and 1970 were examined for changes in percentage female, weighted averages of gender-specific annual income, median education, percentage full time and percentage full year. The third edition DOT's SVP measure was also used. The assumption that changes in concentrations of female workers are negatively related to occupational desirability was not supported. Occupations rated low on income, education, SVP, and percentage full time/full year showed greater variability in percentage female change than occupations rated high on these measures. Finally, the results seriously challenge the sex labeling/tipping effect expectation that occupations filled mainly by women are generally more likely to experience increases in concentrations of women. These findings support a dual labor market interpretation of changes in occupational sexual structure.

Spaeth, Joe L.
1979 Vertical differentiation among occupations. *American Sociological Review* 44(October):746–762.

This paper proposes a theory of vertical occupational differentiation based on the role activities of occupational incumbents. Two dimensions of vertical differentiation, authority and complexity, are derived from the division of labor. Spaeth used the third edition DOT's DATA, GED, and SVP ratings to assess complexity of work and the PEOPLE ratings as an indicator of authority. The DOT's THINGS ratings were not used because the author felt they do not pertain to the full range of occupations but specifically to blue-collar jobs. These concepts are shown to differ from occupational prestige by estimating confirmatory factor models that contain indicators of authority, complexity, and prestige. Results of the analysis are used to suggest resolutions for some anomalous findings of research on the socioeconomic achievement process.

Spenner, Kenneth I.
1977 From Generation to Generation: The Transmission of Occupation. Unpublished Ph.D. dissertation. University of Wisconsin, Madison.

In an effort to identify the aspects of occupations that are transmitted and the way in which these components are transmitted to the occupational aspirations and early occupational attainments of sons and daughters, Spenner developed a set of occupation-specific indicators for role components of the detailed 1960 and 1970 Census occupational categories. Among the variables used in the study were the DOT's SVP, GED, worker functions (DATA, PEOPLE, and THINGS variables), and temperament variables 1, 2, 3, 4, and 8. In examining the validity of these measures, the author concludes that the DOT variables are adequate for his study, but further consideration of the issues of reliability and validity are in order. Spenner's main finding for the structure of role transmission shows that general socioeconomic components and several complexity aspects of work govern the father-son relationship but not the mother-daughter or mother-son relationships, nor do they govern role transmission involving a son's aspirations.

Spenner, Kenneth I.
1979 Temporal changes in work content. *American Sociological Review* 44(December):968–975.

In examining the temporal changes in occupational skill requirements over the course of this century, researchers have focused on (1) change in the marginal distribution of workers to jobs and (2) actual change in the content of jobs. Recent research regarding the first type of change in the American economy suggests a modest skill downgrading since 1900. When the data from the third and fourth edition DOT are used for a sample of jobs, new evidence presented shows small variations for the second type of change for the last 10–12 years. There has been, if anything, a slight upgrading in skill requirements that occurs in a number of sectors of the labor force.

Spenner, Kenneth I.
1980 Occupational characteristics and classification systems: new uses of the *Dictionary of Occupational Titles* in social research. *Sociological Methods and Research* 9(November).

The paper describes the occupational characteristics used in the DOT and U.S. Census classification systems and reports on several characteristics that have recently been estimated for detailed 1960 and 1970 Census occupations. The report includes information on how the measures were generated, some evidence on their validity compared with corresponding individual-level measures, and descriptive statistics for the U.S. labor force. Also, the vector of job characteristics is used to assess the measurement slippage involved in moving between the DOT and the 1970 Census classification.

Spenner, Kenneth I.
1981 Occupations, role characteristics and intergenerational transmission. *Sociology of Work and Occupations* 8(May).

In a study examining the intergenerational covariation in occupational roles the author drew on the DOT's PEOPLE and THINGS variables and SVP ratings. Specific indicators for "routinization," "closeness of supervision," and "uncertainty" were taken from the temperaments variables of the DOT.

Spenner, Kenneth I., Luther B. Otto, and Vaughn R. A. Call
1980 Estimates of Third Edition DOT Job Characteristics for 1970 Census Occupation-Industry Categories. Boys Town Center, Omaha, Nebraska, 68010.

The computer file described in this paper contains weighted estimates of all occupation-related characteristics for 595 1970 Census occupation-industry categories. The authors drew on the DOT's worker function variables, GED, SVF, aptitudes, interests, temperaments, physical demands, and working conditions.

Spergel, Philip

1970 Vocational evaluation: Research and implications for maximizing human potential. *Journal of Rehabilitation* 36(January-February):21–24.

The author states that although the process of work evaluation may continue to be an art, the introduction of validity testing, through well-designed research projects using the technology of programmed, computerized data analysis, should be encouraged. As an example he describes his work on relating work samples with the third edition DOT's worker trait group arrangements and his attempts to validate the results empirically.

Sterne, David M.

1974 The Kuder OIS and rankings of vocational preference. *Educational and Psychological Measurement* 34(Spring):63–68.

Kuder Occupational Interest Survey scores of hospitalized veterans were compared with their preferential rankings of the 77 OIS occupations. These occupations were presented on cards accompanied by an abbreviated version of the DOT title. Low intercorrelation was found, though test-retest reliabilities were .93 and .76, respectively. The OIS responses tended to resemble those of construction and skilled trades workers. Professional occupations related to construction and skilled trades received the highest rankings.

Stevenson, Mary

1973 Women's wages and job segregation. *Politics and Society* (Fall):83–96.

This article points to the dearth of economic analysis on the topic of discrimination against women and argues that women's inferior economic position may result from a highly segregated occupational structure. By using the third edition DOT's GED and SVP scales, occupational categories were ranked from highest to lowest according to the amount of education and training required. Results indicate that men are found in higher occupational groups than women with the same educational attainment and that men receive disproportionately higher wages than women in the same occupational group. Stevenson also cites evidence to support the "crowding hypothesis": women tend to be concentrated in a few limited occupations within an occupational group, while men are more evenly distributed. Thus women do not appear to have the same kind of access to all occupations that men do. Finally, men and women within an occupational group are segregated not only by occupation but also by industry.

Stevenson, Mary

1974 Determinants of Low Wages for Women Workers. Ph.D. dissertation. University of Michigan, Ann Arbor.

Stevenson reviews the literature on working women, job segregation, and wage differentials and presents a model of occupational wage determination. Using the third edition DOT's GED and SVP scales, "occlevels," or occupational categories, were ranked from highest to lowest according to the amount of education and training required. Stevenson found that (1) within occlevels, women's rate of return on investment in education is lower than that of men, (2) within occlevels, women are crowded into fewer distinct occupations than men, and specifically in those occupations with the lowest wages in the occlevel, and (3) within occlevels, men and women are segregated by industry as well as occupation.

Stolzenberg, Ross M.
1975 Occupations, labor markets and the process of wage attainment. *American Sociological Review* 40(October):645–665.

This study attempts to combine sociological models of earnings with economic models of earnings as well as concepts and findings from the sociology of occupations and professions. Drawing on U.S. Census and BLS data as well as two variables from the third edition DOT, Stolzenberg examined, among other things, the impact of SVP on earnings and prestige and the effects of physical demands on the age-wage relationship. The author concludes (1) that labor markets tend to be fragmented along occupational lines, (2) that the processes governing wage attainment vary from one occupation to another, and (3) that occupational differences in these processes can be predicted from and explained in terms of the forces that lead to occupational segmentation of labor markets.

Studdiford, Walter S.
1951 A functional system of occupational classification. *Occupations* (October):37–42.

Studdiford recounts the history of the *Dictionary of Occupational Titles* and describes the work conducted on an innovative classification system for the third edition. This functional system of occupational classification is composed of eight classification components: work done, knowledge and abilities, aptitudes, physical demands, temperaments, working conditions, industry, and training time. The author details the nature of each of the components and concludes with a brief discussion of future areas of study.

Studdiford, Walter S.
1953 New occupational classification structure. *Employment Security Review* 20(September):36–39.

The aims and philosophy of the classification system developed for the third edition DOT are discussed. Studdiford gives an example to illustrate how the worker traits of 4,000 jobs are analyzed and coded. He then answers frequently asked questions about the structure, method, and development of the classification system.

Stump, Robert S.
1976 Occupational Mobility and Career Planning: What is Needed? Paper presented at the Second Career Education National Forum, Washington, D.C., February.

Following a brief review of occupational mobility studies, Stump describes alternative views of occupations, including the third edition DOT's worker trait groups and functional job analysis (involvement with data, people, and things). He suggests work toward a clearer identification of the elements in jobs and an individual's abilities that make occupational changes happen and a more creative approach to job mobility studies. Finally, he outlines a project being conducted by the Center for Vocational Skills designed to explore the issue of transferable skills.

Temme, Lloyd V.
1975 *Occupation: Meanings and Measures.* Washington, D.C.: Bureau of Social Science Research, Inc.

Drawing from economic, psychological, and sociological theories of occupations, Temme has developed a "3R" model to conceptualize career processes and achievements. The 3R model provides equal emphasis on routines, or type of work, requisites, and rewards (i.e., self-direction, prestige, and earnings). Measurement strategies and some practical problems encountered in using unwieldy classification systems are described, and techniques for constructing measures of each dimension of the 3R model are presented. The DOT and its worker traits and worker functions are reviewed. Temme developed a new set of measures of occupational characteristics for occupations used in both the 1960 and 1970 Census classifications. The new measures include the DATA, PEOPLE, and THINGS scales and the GED and SVP scales from the third edition DOT.

Time Share Corporation
1976 *The Guidance Information System (GIS) Guide.* West Hartford, Conn.: Houghton Mifflin Company.

The Guidance Information System (GIS) is a computer-based system that provides information on civilian and military occupations, 4-year and 2-year colleges, graduate schools, and sources of scholarships and financial aid. The GIS's Occupational Information File (OCCU) and Armed Services Occupational Information (ASOC) make use of the DOT's occupational families, codes, definitions, and related job titles. An analysis of DOT interests, aptitudes, physical demands, and working conditions aids clients in choosing appropriate occupational categories.

Tinsley, Howard E. A., and Suzanne M. Gaughan
1975 A cross-sectional analysis of the impact of rehabilitation counseling. *Rehabilitation Counseling Bulletin* 18(March):147–153.

Data obtained from handicap rehabilitation clients were analyzed to determine the immediate and long-term impact of rehabilitation counseling on the work adjustment of the recipients. Respondents' occupations were assigned DOT codes and grouped according to the first digit. Comparison (third edition) of the clients' work adjustment before and after rehabilitation counseling revealed an increase in the employment rate subsequent to counseling and a shift toward employment in occupations that make fewer physical demands on the worker. The percentage of persons employed in professional-managerial and clerical-sales occupations increased from referral to closure, while decreases were observed in miscellaneous and fishing, farming, forestry, and related occupations for the same time period. Further analysis indicated that rehabilitation counseling has a lasting impact on the work adjustment of the client.

Tinsley, Howard E. A., and David J. Weiss
1974 A multivariate investigation of the reinforcer structure of occupations. *Journal of Vocational Behavior* 4(January):97–113.

Earlier research based on 81 Occupational Reinforcer Patterns (ORP's) suggested a nine-category classification of occupations. The present research, based on 148 ORP's, investigated the ability of that classificatory system to assimilate new information. Occupations in each first-digit DOT code group were sampled in proportion to the number of workers in the United States employed in those occupations, and this process yielded a sample representative of the population of occupations available. Cluster analysis of the 148 ORP's produced an eight-category classification of occupations in which five of the original occupational clusters appeared virtually unchanged and the other four were combined into two clusters. One new cluster was identified. The factor structure of these occupational reinforcers was also examined.

Touliatos, John, Byron W. Lindholm, and Amy Rich
1978 Influence of family background on scholastic achievement. *Journal of Experimental Education* 46(Spring):22–27.

The relationship between family background and achievement in school was examined for the two sexes and for social classes. Data were obtained from the cumulative folders of white children in grades 3 through 6. Measures of scholastic achievement were the California Achievement Tests. Social class was defined in terms of father's employment according to the classification system of the DOT. Class I included professional and technical workers, managers, officials, and proprietors; class II was composed of clerical and sales workers; class III was composed of craftsmen and operatives; and class IV was composed of laborers, service workers, and the unemployed. Scholastic achievement was highest for girls and for children living with both parents, for those from smaller families, and for those in the first-born or last-born positions. Interactions with social class are discussed.

Treiman, Donald J.
1977 *Occupational Prestige in Comparative Perspective*. New York: Academic Press.

In chapter 9 the author recommends that the *Dictionary of Occupational Titles* be employed in coding foreign occupational data to the Standard International Occupational Prestige Scale. The occupational definitions provided in the DOT are particularly helpful in determining the appropriate prestige coding when the occupational title is not readily found in the Standard Scale's alphabetical index or in the International Standard Classification of Occupations (ISCO).

Ullman, Charles A.
1971 Measures of learning disability for different purposes. *Journal of Learning Disabilities* 4(April):10–16.

There is a popular preference for intensive, norm-referenced measures, such as age scores and grade scores, in the field of learning disabilities. However, for systematic study, particularly if factors relating to growth are involved, some type of equal-interval measure is preferable to measures using intervals of variable size. The author believes that the development of techniques of absolute measurement may provide the advantages of both equal-interval measures and criterion-based standards. Ullman notes that two of the third edition DOT's features are of special relevance for educational and vocational guidance of persons with learning disabilities: the GED scale and the occupational aptitude patterns.

Viernstein, Mary Cowan
1972 The extension of Holland's occupational classification to all occupations in the *Dictionary of Occupational Titles*. *Journal of Vocational Behavior* 2(April):107–121.

Two methods are presented for extending Holland's occupational classification to include all occupations in the third edition DOT. They enable translation from any DOT code into the corresponding Holland occupational code. Holland's system is based on a theory of personality types and is organized into six major categories.

Wallbrown, Fred H., and Charles B. Huelsman, Jr.
1975 The validity of the Wallach-Kogan creativity operations for inner-city children in two areas of visual art. *Journal of Personality* 43(March):109–126.

The validity of the Wallach-Kogan (W-K) creativity operation was investigated for 73 third and fourth grade children in an inner-city school. The third edition DOT was used to code the occupational status of fathers. Two crayon drawings and clay products were collected from each child and rated by four judges on originality and effectiveness of expression. A satisfactory degree of concordance was obtained among judges' ratings for both dimensions of clay products but not for the crayon drawings. Analysis yielded strong support for the validity of the work operations. A negative relationship was evident between birth order and all five W-K subtests as well as both criterion dimensions for clay products. Finally, the authors' assertion that their creativity operations define a pervasive dimension with discriminant validity from general intelligence is confirmed.

Walls, Richard T., M. S. Tseng, and William D. Ellis
1977 Time and money for vocational rehabilitation of clients with psychotic and psychoneurotic disabilities. *Journal of Occupational Psychology* 50(Spring):37–44.

"Rehabilitated" and "unrehabilitated" psychotic and psychoneurotic clients were compared in connection with two time variables (months in the rehabilitation process and training) and two cost variables (dollars for all services and for facilities). Occupations at closure were assigned third edition DOT codes and grouped according to the first digit. No differences were found between clinical groups on such outcome variables as work status, occupational level, or weekly earnings at closure. As compared to psychotics, psychoneurotics tended to require more time in vocational rehabilitation process and training and less money for rehabilitation facilities. Rehabilitated clients were found to be in the vocational rehabilitation process for less time than unrehabilitated clients.

Walther, Regis S.
1960 The Functional Occupational Classification Project: A critical appraisal. *Personnel and Guidance Journal* 38(May):698–706.

Walther describes the Functional Occupational Classification Project (FOCP) and his efforts to test the usefulness of the classification system. He applied it first to a study made of clerical jobs in the Foreign Service and then to two intensive studies of the job of business executives. He concludes that there are many elements influencing the world of work, such as attitudes, values, energy, types of anxiety, and role requirements, which are not included in the FOCP. In examining the theoretical background of and support for the component parts of the FOCP the author questions the methodology and validity of Cottle's work, on which the interests and aptitudes dimensions are based. He further suggests that rather than measure GED, it would be more useful to examine the different ways in which individuals use their intellect. Finally, in evaluating the worker function variables (DATA, PEOPLE, and THINGS), Walther finds the hierarchy of function levels artificial and unrealistic. In closing he remarks that the FOCP has made a substantial contribution to the field by emphasizing the psychological dimensions not usually considered in conventional job analyses but that its shortcomings and limitations warrant serious attention.

Walther, Regis H.
1964 The Psychological Dimensions of Work: An Experimental Taxonomy of Occupations. Washington, D.C.: George Washington University, Center for the Behavioral Sciences.

This paper proposes an experimental taxonomy of occupations, the Job Analysis and Interest Measurement (JAIM), which is based on psychological dimensions of work. It began by evaluating the degree of success achieved by tests of ability, interests, and personality in predicting job satisfaction or performance or in distinguishing among occupations. An evaluation was also made of various models for classifying occupations and of factor analyses of ability, interests, and personality tests that have been shown to have substantial empirical validation. The third edition DOT's interest and temperament scales were among those examined. The author concludes that the analysis of the job and the individual should be focused on those stable differences among individuals, functioning in psychologically equivalent job situations, that are related to differences in job performance and satisfaction. The author applies the JAIM experimentally to various samples and makes proposals for further research.

Weagraff, Patrick J.
1974 The cluster concept: Development of curricular materials for the public service occupations cluster. *Journal of Research and Development in Education* 7(Spring):45–54.

The advantages and disadvantages of career cluster systems are discussed. An overview of past cluster systems is presented. The author states that ideally, a cluster scheme should encompass all or most of the jobs listed in the DOT. He then describes a public service cluster analysis undertaken by the California State Department of Education and the instructional materials that were produced.

Wehrly, Beatrice L.
1973 Children's occupational knowledge. *Vocational Guidance Quarterly* 22(December):124–129.

School children, 386 fourth, sixth, and eighth graders, took a paper and pencil test to measure their knowledge of 15 occupations. The test was scored using a key developed from information from the *Occupational Outlook Handbook* and the third edition DOT. Data were collected on parents' occupations, IQ, reading achievement, sex, and age. Reading achievement, grade in school, and age all showed a significant positive relationship with the measure of occupational knowledge; IQ and parents' socioeconomic status, however, were not correlated with performance on the occupational test.

Westbrook, Bert W., and Joseph W. Parry-Hill, Jr.
1973 The measurement of cognitive vocational maturity. *Journal of Vocational Behavior* 3(July):239–252.

This report describes the development of an instrument to measure an individual's level of cognitive vocational maturity in six areas: fields of work, job selection, work conditions, education required, attributes required, and duties. By using the third edition DOT and the *Occupational Outlook Handbook* as sources of information about the characteristics and requirements of occupations, multiple-choice items were constructed for each of the selected occupations. Reliability estimates for the subtests as well as criterion-related and construct validity data are presented. It was found that pupils whose vocational choices were in agreement with their field of interest and their ability level scored higher on all subtests than did pupils whose choices agreed with neither their interests nor their ability level.

Witt, Mary, and Patricia K. Naherny
1975 Women's Work—Up from .878. Report on the DOT Research Project. Madison: University of Wisconsin—Extension, Women's Education Resources.

This report (1) determines via established DOT job analysis procedures the adequacy of the DOT's treatment of women's work, particularly as it relates to jobs in the service category, (2) identifies problems in DOT job analysis theory responsible for documented instances of sex discrimination, and (3) develops accurate job descriptions and recommendations to ensure the fair and equitable disposition of women's work in future editions of the DOT.

Woods, Ernest, Jr., and Jules M. Zimmer
1976 Racial effects in counseling-like interviews: An experimental analogue. *Journal of Counseling Psychology* 23(November):527–531.

This study examined racial experimenter effects in counseling-like interviews employing the verbal operant-conditioning paradigm. The general objective was to determine whether significant differences in the "conditionability" of black and white students would be found when the verbal reinforcement was provided by black and white experimenters. Subjects' socioeconomic level was determined by their fathers' occupation, which were rated high or low on the basis of DOT definitions. (There is no further elaboration as to how this was done.) No significant differences were found in the experimenter-subject racial interaction.

APPENDIX

D

Selected Materials Prepared by the Division of Occupational Analysis, U.S. Employment Service

Appendix D is a bibliography of the publications of the Division of Occupational Analysis since 1965, including those of both the national office and the regional field centers. A preliminary version of this list was drawn up on the basis of staff site visits to selected field centers and from discussions with national office representatives. To develop a more comprehensive list, we then asked field center supervisors and national office personnel to add to the basic list any other pamphlets, brochures, or guides that they had contributed to, written, or compiled. The resulting bibliography is organized by field center, with the national office publications listed first (no responses were received from Arizona or Florida).

PUBLICATIONS OF THE DIVISION OF OCCUPATIONAL ANALYSIS SINCE 1965

NATIONAL OFFICE: DIVISION OF OCCUPATIONAL ANALYSIS

U.S. Department of Labor
1965 *Dictionary of Occupational Titles*. Volume 1. Third edition. Washington, D.C.: U.S. Government Printing Office.
1965 *Dictionary of Occupational Titles*. Volume 2. Third edition. Washington, D.C.: U.S. Government Printing Office.
1970 *A Handbook for Job Restructuring*. Washington, D.C.: U.S. Government Printing Office.

1970 *Job Guide for Young Workers*. Washington, D.C.: U.S. Department of Labor.

1971 *Job Descriptions and Organizational Analysis for Hospitals and Related Health Services*. Washington, D.C.: U.S. Department of Labor.

1971 *Relating General Educational Development to Career Planning*. Washington, D.C.: U.S. Government Printing Office.

1972 *Handbook for Analyzing Jobs*. Washington, D.C.: U.S. Government Printing Office.

1972 *Occupations in Electronic Computing Systems*. Washington, D.C.: U.S. Department of Labor.

1973 *Health Careers Guidebook*. Washington, D.C.: U.S. Department of Labor.

1973 *Occupations in Library Science*. Washington, D.C.: U.S. Department of Labor.

1973 *Task Analysis Inventories: A Method for Collecting Job Information*. Washington, D.C.: U.S. Government Printing Office.

1973 *Task Analysis Inventories*. Series One. Washington, D.C.: U.S. Department of Labor.

1974 *Definition Writer's Manual for DOT, Fourth Edition*. Washington, D.C.: U.S. Department of Labor.

1975 *Handbook on Techniques for Obtaining Worker Traits Requirements Data from Employers*. Manpower Administration. Washington, D.C.: U.S. Government Printing Office.

1977 *Dictionary of Occupational Titles*. Fourth edition. Washington, D.C.: U.S. Government Printing Office.

1977 *Career Opportunities in the Telephone and Telegraph Industries*. Washington, D.C.: U.S. Government Printing Office.

1977 *The DOT: Unit I, Executive Briefing*. Washington, D.C.: U.S. Department of Labor.

1977 *The DOT: Unit II, An Overview for Middle Managers and Occasional Users of the DOT*. Washington, D.C.: U.S. Department of Labor.

1977 *The DOT: Unit II, Supplementary Materials*. Washington, D.C.: U.S. Department of Labor.

1977 *The DOT: Unit III, Training Materials for a DOT User*. Washington, D.C.: U.S. Department of Labor.

1977 *The DOT: Unit III, Trainer Package for DOT Users*. Washington, D.C.: U.S. Department of Labor.

1977 *How to Use the Fourth Edition of the DOT*. Washington, D.C.: U.S. Department of Labor.

1978 *Handbook of Occupational Keywords*. Second edition, October. Washington, D.C.: U.S. Government Printing Office.

1978 *Career Opportunities in the Trucking Industry*. Washington, D.C.: U.S. Department of Labor.

1978 *Specific Vocational Preparation (SVP) Estimates for Occupations in the U.S. Department of Labor Dictionary of Occupational Titles (DOT) Fourth Edition*. Interim edition. Washington, D.C.: U.S. Department of Labor, Employment and Training Administration.

1978 *Career Opportunities in the Trucking Industry*. Washington, D.C.: U.S. Government Printing Office.

SERIAL PUBLICATIONS

Frequently Listed Openings. Monthly. Washington, D.C.: U.S. Department of Labor.

Job Bank Openings Summary. Monthly. Washington, D.C.: U.S. Department of Labor.

Labor Market Information Analytical Table Series. Monthly. Washington, D.C.: U.S. Department of Labor.

Occupations in Demand: At Job Service Offices. Monthly. Washington, D.C.: U.S. Department of Labor.

USES Job Openings Information Program Briefing; Briefing Attachments; NEWS 1/18 and 27, 1978; *Occupations in Demand* Extra Edition No. 1 (Fall/Winter) 77–78 and 2 (January 2, 1978).

CALIFORNIA OCCUPATIONAL ANALYSIS FIELD CENTER

1971 Career Guides for Entry Occupations in Data Processing.
1972 A Study and Evaluation of the Third Edition of the *Dictionary of Occupational Titles* as Used by Personnel in Local Office Operations.
1973 Suggestions for Developing an Occupational Library.
1974 Career Guides for Entry Occupations in Food Service.
1974 Career Guides for Entry Occupations in Nursing Services.
1975 *Worker Traits Training Unit*. MA Handbook No. 314.
1976 Career Guides for Entry Occupations in Gas Utilities.
1976 Career Guides for Entry Occupations in Merchandising.
1978 DOT-Keyword Matrix Research Project.
1979 GED Questionnaire. Draft version.
1979 Worker Functions Questionnaire.

Baylin, A.
1976 Career Guides for Entry Occupations in Dental Health.
1976 Career Guides for Entry Occupations in Fire Protection.
1976 Career Guides for Entry Occupations in Printing.

Mellette, W. E.
1976 DOT Coding Guide for Jobs in the Electronics Industry.

Moss, A.
1975 Career Guides for Entry Occupations in Insurance.
1975 Career Guides for Entry Occupations in Telephone Communications.

Phillips, J. E.
1976 The Use of the *Dictionary of Occupational Titles* as a Job Information System in Vocational Counseling.
1979 Worker Function and Job Complexity: A Discussion Paper.

Ryan, P. M.
1976 Career Guides for Entry Occupations in Electrical Utilities.

Safford, J.
1977 Career Guides for Entry Occupations in Banking.

MICHIGAN OCCUPATIONAL ANALYSIS FIELD CENTER

no date Alternative Training Systems Project Description.
no date The First 20 Years, 1958–1978.
no date Interviewer Aid.
no date Interviewer's Desk Aid for using the DOT Effectively.
no date Job Analysis of Light and Sedentary Jobs in Detroit.
no date Job Analysis of Light and Sedentary Jobs in Detroit, Standard Metropolitan Statistical Area.
no date Job Analysis of Light and Sedentary Jobs in Flint.
no date Planning Survey Manual.
no date Trainee's Handbook: Reference Sheets and Exercises.
1970 A Study of New Careers Positions.
1973 Job Analysis of Light and Sedentary Jobs in Saginaw.
1974 Job Analysis of Light and Sedentary Jobs in Bay City, Midland, Michigan.
1974 Job Analysis of Light and Sedentary Jobs in Lansing, Grand Rapids. Battle Creek and Kalamazoo, Michigan.
1975 Definition Writer's Manual for the *Dictionary of Occupational Titles*, Fourth Edition, November 1974.
1975 Information Directory for Counseling, Guidance, and Personnel Work.
1976 Suggested Occupations for Which Vocational Education Programs Can be Developed.
1977 Michigan Occupational Analysis Field Center, Comments.
1978 A Comparable Worth Study of State of Michigan Job Classifications.
1978 Trainer's Handbook.
1979 Trainee Handbook.
Bain, R. Jr., R. Briganti, et al.
1971 An Experimental Employer Relation Unit.
Bemis, S. E., R. L. Bonner, et al.
1974 The New Occupational Aptitude Pattern Structure for the GATB.
Bityk, G., and J. Flynn
1970 BOLT and GED for Counselor's Training.
Davis, M.
no date The E.S. Interviewer Task Analysis Survey: Report to the Interviewer Classification Committee.
1979 Serving Users of Occupational Information: Making Worker Traits Ratings Available.
Downes, K.
1978 Matching Worker Traits to Occupational Traits in Rehabilitation Counseling.
1978 Occupational Information for Highland Park Community College.
1978 Occupational Information for Murray-Wright High School.
1978 Overview of Career Education.
1978 Use of the DOT in Matching Client Traits With Occupational Traits: A Survey.
1979 Interfacing the DOT's Job Analysis Schedule With Competency Based Education Task List on Child Care.

1979 Work-Education Council Occupational Information.

Downes, K., and L. Sorkin
1979 Open Cover Before Striking . . . Out or How to Find a Job.

Fhols, A.
1976 Red Ker-Young Recovery Systems.

Goode, W.
1977 The Special Projects Section of the Michigan Occupational Analysis Field Center Program.
1978 Service to MESC Local Office Units.

Goode, W., and K. Downes
1979 Using Occupational Analysis Field Center's Information in Competency Based Education.

Goode, W , and R. Wilks
1979 Data Pertaining to New Jobs and Technologies Found in the Medical Services Planning Survey, 1978–9.

Kearney, T.
1974 Report on Various Issues.

Lipson, L.
1978 Summary Report of Michigan's Orientation and Training in Use of the Fourth Edition *Dictionary of Occupational Titles.*

Norris, C., Jr.
1979 Jobs for Which a High School Diploma or Less is Required, in the Detroit Metropolitan Area.

Stottlemyer, E. C.
1978 Alternative Training Systems.

Taylor, D.
1975 Report on the National Symposium on Task Analyses/Inventories: The Job Analysis Technique of the United States Employment Service.

Willoughby, E.
1977 Michigan Analysis Field Center's Comments on Relevant Issues in the Occupational Program.

MISSOURI OCCUPATIONAL ANALYSIS FIELD CENTER

1965 Post Guide for Analyzing Jobs.
1965 Project #11 (Conditions Under Which a Job Should be Considered Obsolete for DOT Purpose).
1966 Temperament Manual.
1968 Training Materials.
1972 *Dictionary of Occupational Titles,* 3rd Edition—Comments and Criticisms.
1972 Occupational Group Arrangement Survey Report.
1972 Worker Traits Desk Aid.
1979 Monthly Report of Technical Assistance.

Armstrong, D.
1974 Careers in Air Pollution Control.

Cassidy, A.
no date Information Guide—Field of Transportation.

Cassidy, A., and E. Neuwirth
1970 Welding, Cutting, Soldering and Brazing Informational Guide.
Diamond, D. E., and H. Bedrosian
1970 *Industry Hiring Requirements and the Employment of Disadvantaged Groups*. New York: New York University School of Commerce.
Kuhn, B.
no date Industry Narrative Report of Drug Preparations and Related Products.
1969 Employment Opportunity Guides.
1973 Suggestions for Clarification or Revision of Handbook for Analyzing Jobs.
1977 Show Me Jobs in Banking.
1977 Show Me Shoe Manufacturing.
1978 Field Center Methodology.
1978 Glossary of Office Machinery and Equipment.
1979 Guide for Occupational Exploration.
1979 Learning to Use the 4th Edition DOT.
1979 Occupations in Museums, Zoos, and Other Interesting Places.
1979 Training Material for the Guide for Occupational Exploration (GOE).
Kuhn, B., and J. DeLassus
1979 Fifth Edition DOT, Phase II, B2—OGA/SOC Classification Structure.
Kuhn, B., and R. Grebe
1973 Training Materials.
Kuhn, B., and G. Wolf
1969 Neighborhood Youth Corps Assignment.
McCarthy, M., and E. Neuwirth
1976 Third Edition, DOT Training Material.
Neuwirth, E.
1979 *Dictionary of Occupational Titles*—Employment Service Basic Training, Training Unit No. 9, and 9-A.
Neuwirth, E., and M. McCarthy
1979 DOT/Keyword Supplement.
Phelan, D.
1972 Job Restructuring Study of Physical Therapy Activities at Irene Walter Johnson Institute of Rehabilitation.
1979 Environmental Protection Careers Guidebook.
Phelan, D., and J. Lyles
1979 Proposed Career Publication on Occupations in Education.
Phelan, D., and E. Neuwirth
1979 Health Careers Guidebook.
Smith, R.
no date Narrative Report of the Pen and Pencil Industry.
1974 The Missouri Occupational Analysis Field Center.
1975. Occupational Analysis and Research.
1977 Occupational Analysis.
1978 Career Opportunities in the Solar Energy Industry.
1979 Occupational Group Arrangement Desk Aid.

Smith, R., and B. Kuhn
1979 Assignment of DOT Codes to Missouri State Merit System Job Classifications.
Teiber, B. J.
1977 Introduction to the 4th Edition of the DOT.

NEW YORK OCCUPATIONAL ANALYSIS FIELD CENTER

1967 Counselor's Desk Aid.
1967 Counselor's Handbook.
1968 Occupational Monographs, Nassau-Suffolk.
1969 Arrangement of Worker Trait Groups According to Interest Factors.
1969 Arrangement of Worker Trait Groups by Temperament Factors.
1969 Desk Aid 1.
1969 Job Briefs.
1969 Vocational Education and Occupations.
1970 Desk Aids: Worker Functions and Worker Traits.
1971 Career Exploration Questionnaire.
1971 Consolidated Index of Occupational Descriptions.
1971 Definitions and Benchmarks, Worker Functions, Interests, Temperaments. (Rev.)
1971 Mid-Hudson Area Occupational Monographs.
1973 Job-Analysis Study of Bookkeeping and Related Jobs.
1974 Interviewing Aids for Clerical Occupations.
1974 Interviewing Aids for Industrial Occupations.
1974 Interviewing Aids for Service Occupations.
1975 Applicant-Appraisal Data Index.
1975 Military-Civilian Occupational Source Book.
1975 Supplementary DOT Classification Bulletins.
1975 Techniques for Obtaining Worker Traits Requirements Data from Employers.
Berwitz, C. J.
1975 *The Job Analysis Approach to Affirmative Action*. New York: John Wiley & Sons.
1976 Guide to Local Occupational Information.
1977 An Application of the Labor Department's Job Restructuring Methodology to Physical Therapy Activities.
1977 Task Bank of Physical Therapy Activities.
1978 Alphabetic Arrangement of Occupational Divisions and Groups (for DOT 4th Edition).
1978 Career Opportunities in the Electric Power and Gas Utilities Industries.
1978 The Importance of Job Analysis in the U.S. Department of Labor's Aptitude-Test Development Program: A Report on Pilot Studies at Six Plants of Owens-Illinois Corporation.
1978 JBSS Coding Guide for Occupations in the Apparel Industries.
1978 JBSS New York's Computer System.
1978 Military-Civilian Occupational Source Book. Second edition.

Zunder, P. M., D. S. Bickford, K. Charron, E. H. Jillson, and W. M. Rose
1978 The Utility of a Task Checklist as a Data-Collection Method for Job Analysis.

NORTH CAROLINA OCCUPATIONAL ANALYSIS FIELD CENTER

1967 Bureau of Census to 3rd Edition Conversion Table.
1967 Economic Opportunity Aids/Flyers (6).
1967 North Carolina Supplement to 3rd Edition DOT.
1968 Employment Opportunity Aids (40).
1968 An Exploratory Study to Determine the Usefulness of Employment Opportunity Aids in Counseling and Placement of the Disadvantaged.
1968 Neighborhood Youth Corps Occupational Analysis Project (38 modified schedules and/or composite schedules).
1969 DOT 3rd Edition to Bureau of Census Conversion Table.
1969 North Carolina Supplement to 3rd Edition DOT—Selected Characteristics of Occupations by Worker Traits and Physical Strength for Hosiery Industry.
1970 Brochure on Occupations and Trends in Manufacture of Tobacco.
1970 North Carolina Supplement to 3rd Edition DOT.
1972 Instructor's Guide for Using Volume 2 of 3rd Edition DOT.
1972 Job Analysis Training Manual; Trainee Work Booklet; and Booklet Handout (Job Analysis—Its Products and Uses).
1973 DOT Supplement to Eliminate Sex-and-Age Referent Language from 3rd Edition DOT.
1973 North Carolina Supplement to 3rd Edition DOT.
1974 Third Edition DOT Industries to 1972 SIC Conversion Table.
1979 Conversion Table of Code and Title Changes 3rd to 4th Edition DOT.
1979 Fourth Edition DOT Industries-to-1972 SIC Manual Conversion Table.
1979 Work Fields and MPSMS Questionnaires.
Forthcoming Furniture Industry Brochure.

TEXAS OCCUPATIONAL ANALYSIS FIELD CENTER

no date Trainer Package for Introducing the Second Edition of the Handbook of Occupational Keywords.
no date Self-Training Manual for the Fourth Edition of the *Dictionary of Occupational Titles.*
1967 *Dictionary of Occupational Titles*, Third Edition, Training Unit.
1969 Worker Traits Training Unit.
1975 Occupations.

UTAH OCCUPATIONAL ANALYSIS FIELD CENTER

no date OGA and Industry Designation Definitions.
Forthcoming Handbook for Job Analysis.

WASHINGTON OCCUPATIONAL ANALYSIS FIELD CENTER

no date Project #19: Evaluation of the Adequacy of Job Analysis Techniques. Final report.
1968 Key #1: Index to DOT Worker Trait Groups by Last Three Digits of the Occupational Code Numbers.
1969 Key #2: Key to Worker Functions and the Qualifications Profile.
1970 Mobile Home Industry in Washington State.
1976 Salmon-Roe Processing for the Japanese Market—1976 Studies.
1978 Interrelationship of the DOT With Other Classification Systems. Unpublished paper prepared on Project 9.
1979 Agricultural and Related Occupations DOT—4th Edition 1977.

WISCONSIN OCCUPATIONAL ANALYSIS FIELD CENTER

no date Job Analysis Training.
no date Papermaking Career Opportunities.
no date Registration Reviewer Training.
1978 Wisconsin OAFC Job Analysis Procedure Supplement (revised by staff in 1978).
Alexander, J.
1968 Technical Report on Occupations in Numerically Controlled Metal-Cutting Machining.
1969 Occupations in Automotive Services.
Bartz, D.
no date An Interviewing Aid.
no date General Labor Positions in Various Fields of Work.
no date Significant, Intermediate and Not Significant Aptitudes.
Beutel, B.
1972 Jobs in Ship and Boat Building.
1973 Jobs in the Manufacture of Paper Products.
Beutel, B., and B. Marquis
no date Corrections Industries Special Project. Final report.
Beutel, B., R. Nilsson, and A. Iverson
1973 Jobs in the Manufacture of Paper Products.
Gaginis, S. I.
no date A Comparison: The DOT and HOOK.
no date Proposed Guide for Preparing the Job Service Job Specification/DOT Occupational Code Request Form.
no date Special Job Evaluation Project for 57 Production Jobs.
Heilman, R.
1970 Beef and Dairy Cattle Raising . . . Jobs.
1971 Agricultural Service Jobs.
1972 Jobs in the Manufacture of Buildings.
Iverson, A.
no date Jobs in Water Quality.
1975 Papermaking Processes and Jobs.

Juhnke, R.

1969 Dairy Products Occupations in Northeastern Wisconsin.

1970 Occupations and Trends in the Dairy Products Industry.

Koppenhaver, K.

1972 Jobs in the Forging Industry.

Marquardt, E.

1970 How Beer is Made—Malt Liquor Industry Jobs.

1971 Auto Assembly Jobs.

1975 Wisconsin OAFC Job Analysis Procedures.

Marquis, B.

1978 A Work-Study Guide to the Use of the DOT.

1979 Improved Use of the DOT as a Placement Tool: Status of Training Project.

1979 Status of the Work Study Guide.

Miller, W.

1970 Fruit and Vegetable Processing Jobs.

Nilsson, R.

1972 Papermaking Jobs.

1979 Interviewing Aids.

Potts, F.

1969 The World of Work—Engine Manufacturing.

1969 The World of Work—Glue and Gelatin.

1969 The World of Work—Industrial Clean Rooms.

1970 Jobs in the Plastics Industry.

Schoenick, T.

1971 Rehabilitation Therapy—Art Therapy . . . the Occupation.

Schoff, P., and S. Gagainis

1973 Survey of Adequacy of the Department of Labor's *Dictionary of Occupational Titles*, 3rd Edition.

Seimers, K.

1969 The World of Work—Abrasive Products.

APPENDIX

E

The Rating of DOT Worker Functions and Worker Traits

PAMELA S. CAIN *and* BERT F. GREEN, JR.

In the course of producing the DOT, jobs and occupations were rated for a variety of characteristics, called worker functions and worker traits. These ratings and the procedures by which they were assigned are described in chapter 6. Because of the widespread and varied use made of these ratings both inside and outside the U.S. Employment Service, it is especially important that they be accurate—that is, that they measure what they purport to measure.

The ratings assigned to DOT occupations, like all such ratings, are subject to various influences, some of which are legitimate bases of variation and some of which are not. An occupation might be rated differently on a given characteristic not only because it actually requires different levels or amounts of the characteristic in question but also because of the particular circumstances in which the ratings were made, characteristics of the raters, specific features of the occupation itself, etc. Such ratings invariably entail some measurement error; they reflect, to some extent, characteristics other than those they are supposed to measure.

There are several reasons to suspect that the ratings of DOT occupations for worker functions and worker traits are subject to error. First, the factors that the DOT scales purport to measure are vague and ambiguously defined. It is not readily apparent what they are intended to measure, i.e., what the "true" scores of the phenomenon being rated should be. Worker functions, for example, are said to "express the total level of complexity of the job-worker situation" (U.S. Department of Labor, 1972:5), but "complexity" is never defined or specified further. Sidney Fine, who was instrumental in developing worker functions, has also written that they reflect skill estimates (Fine, 1968a:374) and worker autonomy, i.e., the extent to which workers are engaged in "prescribed versus discretionary duties" (Fine, 1968b:7).

The reliability of the ratings is also called into question by the extremely high correlations (of the order of .90) between some of them and measures of the social status or prestige of occupations. This concern has been voiced about general education development (GED) by several researchers, notably Siegel (1971) and Duncan et al. (1972).[1]

Concern about the reliability of the DOT factors arises for other reasons as well. Analysts reported difficulty in assigning scores on certain factors, especially specific vocational preparation (SVP) and aptitudes. Reasons cited for this were the ambiguity of the factors and the inadequacy of instructions contained in the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972). Furthermore, production of the fourth edition DOT was highly decentralized. Analysts were spread across 10 field centers and 1 special project, and there was reportedly little communication or coordination of effort among them, nor were their activities closely supervised or standardized by the national office.

In order to assess the impact of several potential sources of variation in these ratings, we carried out an experimental study to (1) determine the overall level of reliability for selected worker functions and traits and (2) identify significant bases of variations in or influences on the ratings. In the latter regard we investigated whether the ratings were influenced by (1) analysts' field center affiliation, (2) the type of occupation being rated, i.e., whether in service or manufacturing, (3) the general education development level of the occupation, (4) the particular job description (one of two) of the occupation being rated, and (5) the particular analyst making the rating. The interactions of these various influences were also taken into account in the design and analysis of the study. The specific effects, along with their labels and a brief description of each, are given in Table E-1.

STUDY DESIGN

With the assistance of national office personnel we asked six experienced job analysts at each field center with at least 6 months' training and experience to rate one of two sets of job descriptions. If more than six

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[1] If an occupation's social standing is indeed dependent on its functional requirements, as some theorists, notably Davis and Moore (1945) have argued, then it could be argued alternatively that correlations of this magnitude are evidence of the validity of the worker functions.

TABLE E-1 Sources of Variation in Ratings of Occupational Characteristics

Source Label	Description of Effect
1. T	type of occupation
2. G	level of general educational development (GED)
3. TG	interaction of job type and GED
4. J(TG)	jobs nested within the interaction of job type and GED
5. C	center
6. CT	interaction of center and job type
7. CG	interaction of center and GED
8. CTG	interaction of center with interaction of job type and GED
9. CJ(TG)	interaction of center and jobs nested within interaction of job type and GED
10. DJ(TG)	interaction of description and jobs nested within the interaction of job type and GED
11. CDJ(TG)	interaction of center with interaction of description and jobs nested within interaction of job type and GED
12. R(CD)	raters nested within the interaction of centers and description
13. RT(CD)	interaction of raters and job types nested within interaction of centers and description
14. RG(CD)	interaction of raters and GED nested within interaction of centers and description
15. RTG(CD)	interaction of raters with interaction of job type and GED nested within interaction of centers and description
16. RJ(TGCD)	residual

LEGEND: T, one of two types of occupation: service versus manufacturing; G, one of four levels of GED; J, one of three DOT occupations within eight categories of job type by GED; C, one of seven field centers; D, one of two job descriptions for given DOT occupation; R, one of 42 individual occupational analysts.

experienced analysts were available at a given center, we chose six at random to participate in the study. Three centers with fewer than six experienced analysts (Florida, Texas, and Utah) were eliminated from the analysis, although they did participate in the actual ratings task. Analysts at the Arizona special project participated in a pretest of the ratings task. Each set of job descriptions represented 24 distinct DOT occupations. To select occupations and job descriptions, we created two types of jobs: (1) "service," which consisted of base title occupations in the clerical and sales and service categories of the DOT, and (2) "manufacturing," which consisted of base title occupations in the DOT categories of processing, machine trades, benchwork, and structural occupations. Preliminary analysis established that the variation in ratings over all occupations is approximately the same in these two categories (the standard deviation of GED for service occupations is .784 versus .880 for manufacturing occupations; the range of GED is 1–6). This equivalence offered some measure of confidence that we could make valid comparisons between the reliabilities of the two categories.

Within these two broad categories of occupations, titles were stratified by four levels of GED. A set of base title occupations was then selected at random within each of the eight combinations of job type (2) by GED (4). The source files of these occupations were inspected in order to locate titles with two adequate job descriptions.[2] Descriptions were judged adequate if items 4 (job summary) and 15 (description of tasks) of the job analysis schedule had been completed according to instructions in the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972). Thus the description had to contain information on the purpose and nature of the job; the significant involvement of workers with data, people, and things; the level of such involvement; and a detailed description of job tasks with an indication as to the amount of time spent on each. If fewer than two acceptable descriptions were available for an occupation, we eliminated it and proceeded to the next randomly selected occupation in the set. If more than two acceptable descriptions were available for an occupation, two of the descriptions were chosen at random. In this way, two job descriptions for each of three base title occupations were selected for eight combinations of job type by GED. (It might be noted in passing that we had to go through 92 DOT codes in order to obtain the necessary two descriptions for each of 24 occupations, yet another indication of the poor quality of the DOT source data.)

Fifteen occupations (16 percent of the total number of codes we inspected) were eliminated because we could not match the code we had obtained from the DOT summary tape (provided by the national office) to a code in the source data. In most such cases one of the worker function codes on the tape was one point lower than it was in the source data. The systematic nature of the discrepancy resulted from some last-minute changes in occupational codes prior to publication of the DOT that were apparently not incorporated on the summary tape.

The results are based on the ratings of 42 analysts at 7 field centers. Each analyst rated 24 job descriptions taken verbatim from job analysis schedules. Each job description was rated with respect to worker functions (DATA, PEOPLE, and THINGS); training times (the reasoning, math, and language components of GED, plus SVP); all six physical capacities; and all seven environmental conditions. Each description was thus rated on 20 separate factors. The ratings task and the rating form used closely approximated the ratings made in the normal course of job analysis for the DOT, although analysts were unable to observe the jobs directly, as they would usually do.

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[2] The source materials for the fourth edition DOT are housed at the North Carolina field center. We wish to express our gratitude to the staff there for the assistance we received in choosing job descriptions for our study.

The rating task was administered to the 42 raters at their respective centers on June 11, 1979, under controlled conditions. Analysts worked in conference rooms rather than at their desks and were proctored by the field center supervisor or a designated assistant. There was no time limit and analysts were instructed to work at their normal pace. Analysts were also instucted not to consult the DOT or one another while making the ratings. Ratings were assigned according to procedures contained in the *Handbook for Analyzing Jobs*. Raters were free to consult the *Handbook* for additional instruction or bench marks, if needed.

Supervisors were not requested to keep track of the time required to complete the ratings, but according to informal reports most analysts finished in about 4 hours. On the last page of the questionnaire, analysts were invited to comment on the ratings task. Eighteen of the 42 raters did so. Almost every comment noted that the descriptions contained insufficient information to rate jobs for physical capacities and environmental conditions. Some analysts noted the same difficulty for SVP. Despite this difficulty, analysts completed almost all of the ratings, and there were few missing data. Of the total of 20,160 ratings (42 raters rating each of 24 jobs for 20 factors), only 21 were not made. For these, missing data were replaced with sample means. The amount of missing data is so small that this replacement procedure should have a negligible effect on our estimates.

RESULTS

An analysis of variance technique is used to calculate the reliability of the ratings for the worker functions (DATA, PEOPLE, and THINGS), GED, SVP, STRENGTH, and LOCATION factors. For a discussion of the rationale for and use of the analysis of variance to calculate reliabilities, see, for example, Lindquist (1953). Generally, the advantage of this method over other methods is that it enables the user to disentangle the effects of separate influences on the ratings and hence to estimate the amount of error due to each source. Complete results from the analysis of variance are presented in Tables E-2, E-3, and E-4. (These tables are not discussed but are provided for the interested reader.)

Table E-5 presents three estimates of the reliability of each rating, making different assumptions for each about what constitutes "error

TABLE E-2 Complete Analysis of Variance for DATA

Effect	Degrees of Freedom (DF)	Mean Squares (MS)	Denominator	Denominator DF	F	Divisor	Variance Component (VC)
1. T	1	381.349	8.103 (7.768 + .897 − .562)	16	47.06	504	.741
2. G	3	858.202	7.967 (7.768 + .761 − .562)	16	107.72	252	3.374
3. TG	3	54.791	8.094 (7.768 + .888 − .562)	16	6.80	126	.371
4. J(TG)	16	7.768	2.361 (2.212 + .711 − .562)	24	3.30	42	.129
5. C	6	2.199	–	–	–	144	–
6. CT	6	1.526	–	–	–	72	–
7. CG	18	.930	–	–	–	36	–
8. CTG	18	.734	–	–	–	18	–
9. CJ(TG)	96	.707	–	–	–	6	–
10. DJ(TG)	24	2.212	.562	448	3.90	21	.079
11. CDJ(TG)	144	.711	.562	448	1.26	3	.050
12. R(CD)	28	1.493	.562	448	2.65	24	.039
13. RT(CD)	28	.897	.562	448	1.60	12	.028
14. RG(CD)	84	.761	.562	448	1.35	6	.038
15. RTG(CD)	84	.888	.562	448	1.88	3	.109
16. RJ(TGCD)	448	.562	–	–	–	1	.562

TOTAL, 5.515; minimum, 4.615; medium, 4.694; maximum, 4.953; *r*(minimum) = 4.615/5.515 = .836; *r*(medium) = 4.694/5.515 = .851; *r* (maximum) = 4.953/5.515 = .898.

TABLE E-3 Complete Analysis of Variance for PEOPLE

Effect	Degrees of Freedom (DF)	Mean Squares (MS)	Denominator	Denominator DF	F	Divisor	Variance Component (VC)
1. T	1	218.215	8.868 (8.365 + 1.012 − .509)	16	24.61	504	.415
2. G	3	1,108.305	8.563 (8.365 + .707 − .509)	16	129.43	252	4.364
3. TG	3	18.486	—	16	—	126	—
4. J(TG)	16	8.365	8.55 (8.428 + .631 − .509)	24	.98	42	0.000
5. C	6	1.766	—	—	—	144	—
6. CT	6	.789	—	—	—	72	—
7. CG	18	1.843	—	—	—	36	—
8. CTG	18	.760	—	—	—	18	—
9. CJ(TG)	96	.581	—	—	—	6	—
10. DJ(TG)	24	8.428	.509	448	16.56	21	.377
11. CDJ(TG)	144	.631	.509	448	1.24	3	.041
12. R(CD)	28	2.089	.509	448	4.10	24	.066
13. RT(CD)	28	1.012	.509	448	1.99	12	.042
14. RG(CD)	84	.707	.509	448	1.39	6	.033
15. RTG(CD)	84	.787	.509	448	1.55	3	.093
16. RJ(TGCD)	448	.509	—	—	—	1	.509

TOTAL, 5.940; minimum, 4.779; medium, 5.156; maximum, 5.431; *r*(minimum) = 4.779/5.940 = .804; *r*(medium) = 5.156/5.940 = .868; *r* (maximum) = 5.431/5.940 = .914.

TABLE E-4 Analysis of Variance Results: Degrees of Freedom and Mean Squares

Effect	Degrees of Freedom (DF)	Mean Squares								
		DATA	PEOPLE	THINGS	GED-REASON	GED-MATH	GED-LANGUAGE	SVP	STRENGTH	LOCATION
1. T	1	381.349	218.215	37.145	212.209	102.542	275.525	274.480	24.453	44.587
2. G	3	858.202	1,108.305	22.233	230.109	135.445	211.657	1,003.190	18.009	12.032
3. TG	3	54.791	18.486	183.072	1.845	10.805	5.496	5.199	7.223	12.534
4. J(TG)	16	7.768	8.365	43.953	4.411	3.270	4.130	18.391	10.894	7.357
5. C	6	2.199	1.766	37.312	2.753	5.794	1.455	11.609	2.626	.332
6. CT	6	1.526	.789	7.517	.950	.657	.446	3.440	.971	.282
7. CG	18	.930	1.843	4.973	.710	.861	.504	.862	.396	.217
8. CTG	18	.734	.760	1.725	.333	.345	.273	.783	.449	.244
9. CJ(TG)	96	.707	.581	2.201	.208	.279	.213	.788	.209	.195
10. DJ(TG)	24	2.212	8.428	28.199	2.627	.968	1.803	5.444	3.158	.266
11. CDJ(TG)	144	.711	.631	2.875	.328	.460	.382	1.029	.258	.134
12. R(CD)	28	1.493	2.089	8.201	.651	2.852	2.810	6.108	.906	.106
13. RT(CD)	28	.897	1.012	3.610	.688	.888	.689	1.313	.377	.122
14. RG(CD)	84	.761	.707	3.843	.317	.546	.478	1.000	.358	.113
15. RTG(CD)	84	.888	.787	2.783	.229	.236	.420	1.022	.318	.107
16. RJ(TGCD)	448	.562	.509	2.058	.214	.201	.204	.558	.192	.099

TABLE E-5 Variance Components for Significant Effects and Estimated Reliabilities[a]

Effect	DATA	PEOPLE	THINGS	GED-REASON	GED-MATH	GED-LANGUAGE	SVP	STRENGTH	LOCATION
1. T	.741	.415	.000	.411	.196	.538	.507	.026	.074
2. G	3.374	4.364	.000	.895	.523	.822	3.906	.027	.018
3. TG	.371	—	1.098	—	—	—	—	—	—
4. J(TG)	.129	.000	.356	.040	.049	.051	.297	.185	.168
5. DJ(TG)	.079	.377	1.245	.115	.036	.076	.233	.141	.008
6. CDJ(TG)	.050	.041	.272	.038	.086	.059	.157	.022	.033
7. R(CD)	.039	.066	.256	.018	.110	.109	.231	.030	.000
8. RT(CD)	.028	.042	.092	.040	.057	.040	.063	.015	.002
9. RG(CD)	.033	.033	.298	.017	.057	.046	.074	.028	.002
10. RTG(CD)	.109	.093	.242	.005	.012	.072	.155	.042	.003
11. RJ(TGCD)	.562	.509	2.058	.214	.201	.204	.558	.192	.099
TOTAL	5.515	5.940	5.917	1.793	1.327	2.017	6.181	.708	.407
r(minimum)	.84	.80	.25	.75	.58	.70	.76	.34	.64
r(medium)	.85	.87	.46	.82	.61	.74	.80	.54	.66
r(maximum)	.90	.91	.65	.88	.85	.90	.92	.73	.76

[a] Reliabilities are calculated under three different assumptions about sources of error. See text for explanation.

variance." Reliabilities are calculated from variance components estimated according to procedures in the work of Green and Tukey (1960). The variance components shown in the body of Table E-5 are the proportion of variation in a given characteristic due to particular effects. Variance components were calculated only for effects that were statistically significant at the 1-percent level of probability. Comparing all the analyses, we found that in most of them a standard pattern emerged in which the effects related to analysts' field center affiliation (effects C through CJ(TG)) were nonsignificant. Thus variance components were not calculated for these effects.

The nonsignificance of field center effects is a substantively important finding. It is also somewhat unanticipated, given the lack of coordination among field centers. What it means is that ratings do not vary according to the particular features of field centers.

Reliabilities are calculated across all 24 occupations. Each reliability represents the proportion of total variation due to true sources. In all the analyses the effects of occupation, type of job (manufacturing versus service), and the general education development level of the job (T through J(TG)) are considered to be true or valid sources of variation in the ratings. In all, the residual (RJ(TGCD)) is assumed to be random or error variance. As noted, however, we made alternative assumptions about what other effects constituted error. In calculating the first set of reliability estimates (labeled "minimum") we considered variation due to the particular description being rated (DJ(TG)) and variation due to the assorted rater effects (CDJ(TG) through RTG(CD)) to be error, in addition to the residual. This set of reliabilities—the most stringent, lower-bound estimate—gives us a sense of the reliabilities that would be obtained if each occupation were rated by one rater on the basis of only one description.

Under the second assumption, variation due to different descriptions is considered to be true or valid, and only rater effects in addition to the residual are considered to be error. These estimates of reliability (labeled "medium") can be interpreted as the reliabilities that would be obtained if each occupation were rated by one rater on the basis of two job descriptions.

The third set of reliabilities (labeled "maximum") relaxes the assumptions about error even more. In these estimates, only the residual effect is considered to be error; the differences between raters and field centers are taken as valid sources of variation.

The difference between reliabilities in the first and second set of estimates indicates the contribution of the job description effect per se to the total variation in the ratings. Similarly, the difference between the second and third reliability estimates indicates the contribution of the rater effects per se.

Turning to the results in Table E-5, because of the presence of significant, sometimes relatively large, job description and rater effects, we note that the three sets of estimates often differ considerably from one another. The impact of the job description effect is best seen by comparing the first and second sets of reliability estimates for each factor. While differences between the two sets average .08, they range from .01 (DATA) to .21 (THINGS), an indication that the ratings on some factors are more sensitive than others to particular features of the job description. The effect of job description is relatively small for DATA, GED-MATH and GED-LANGUAGE, SVP, and LOCATION. It has a larger impact on the remaining ratings, especially those for PEOPLE, THINGS, GED-REASON, and STRENGTH. Comparison between the second and third reliability estimates reveals large rater effects on all the ratings. The effect is especially large for THINGS (a difference of .19), GED-MATH (.24) and GED-LANGUAGE (.19), and STRENGTH (.19).

Across characteristics the reliabilities also vary greatly. Under the most stringent assumptions (r(minimum)), reliabilities range from a low of .25 for THINGS to a high of .84 for DATA. The second set of estimates probably embodies the most realistic assumptions about what constitutes error. These reliabilities are not especially high, ranging from .46 for THINGS to .85 for DATA. Under the most relaxed assumption, reliabilities (r(maximum)) are up to fairly acceptable levels, in the high .80's and low .90's for all of the ratings except THINGS, STRENGTH, and LOCATION. It should be kept in mind, however, that in these estimates, rater variation is considered to be true variance, hardly a tenable assumption. These estimates, in fact, are only useful insofar as they enable us to calculate the magnitude of variation due to raters.

The especially low reliabilities of the THINGS and STRENGTH scales may well result from insufficient information in the description being rated. Of the 18 analysts who made comments at the end of the study, most noted that the descriptions contained insufficient information to rate jobs for physical capacities and environmental conditions. Although a similar difficulty was not reported for the THINGS factor, the scale used to rate THINGS is almost completely dominated by functions that deal with the relation of the worker to machines (five of its eight levels). Thus the lower reliabilities on THINGS might be due to the difficulty of assigning ratings to occupations with tasks in which machines are unimportant.

Overall, the reliabilities are low enough to cause concern. The large effects of job description (the difference between the medium and minimum estimates) reveal that for each of the characteristics there is considerable diversity in the description of jobs classified within an occupation. Certainly there is more than would be assumed from a reading of the *Definition Writer's Manual* (U.S. Department of Labor, 1974) or from the fact that, typically, only a small number of jobs are analyzed for each occupation (see chapter 7). Moreover, although there is no significant difference beween ratings across field centers, there are significant differences across analysts within field centers. Thus ratings are substantially affected by the idiosyncrasies of individual analysts.

The implications of these results are twofold. If a reliable rating is desired of a given characteristic for a given occupation, it will be necessary both to use more raters and more descriptions per occupation and to average the sets of ratings thus obtained. The number of raters and descriptions needed to achieve a desired level of reliability can be estimated from the results presented here using the general Spearman-Brown formula (see, for example, Allen and Yen (1979)). Thus starting with an initial r (medium) of .80 (for example, SVP), a reliability of .89 can be achieved by increasing the number of raters to two; if three raters are used, a reliability of .93 can be obtained. Substituting jobs for raters and using the same procedures, with r (minimum) as the base, we find that by having the raters rate two job descriptions per occupation the reliability of SVP will increase from .76 to .86; by having raters rate three job descriptions a reliability of .90 can be obtained. Therefore for all of the factors, both the number of raters and the number of jobs rated per occupation will need to be increased somewhat in order to achieve satisfactory levels of reliability. The increase needed will be relatively smaller for those factors with higher initial reliability.

In a second analysis of these ratings we calculated reliabilities separately for the two types of jobs—service and manufacturing—in order to see whether the ratings were less reliable for the service category. We reasoned that they might be because the scales were developed during a historical period in which manufacturing jobs predominated. The scales might as a result be better suited to the rating of manufacturing jobs. Furthermore, because most occupations contained in the DOT are in manufacturing industries, analysts are presumably more practiced in rating such occupations. The reliabilities by job type—service versus manufacturing—are presented in Table E-6. These reliability estimates were calculated using the same set of assumptions about error that were used in previous analysis. For all the characteristics with only one exception (STRENGTH), all three estimates of reliability are lower for the service occupations than they are for manufacturing.

These results suggest that particular attention should be paid to the rating of service occupations in order to bring their reliabilities up to par

TABLE E-6 Estimated Reliabilities, by Type of Occupation[a]

Characteristic[b]	Service	Manufacturing
DATA		
r(minimum)	.694	.880
r(medium)	.727	.889
r(maximum)	.798	.918
PEOPLE		
r(minimum)	.666	.908
r(medium)	.795	.933
r(maximum)	.830	.972
THINGS		
r(minimum)	.107	.186
r(medium)	.329	.406
r(maximum)	.632	.637
GED–REASON		
r(minimum)	.652	.694
r(medium)	.717	.794
r(maximum)	.792	.888
GED–MATH		
r(minimum)	.422	.629
r(medium)	.431	.682
r(maximum)	.771	.878
GED–LANGUAGE		
r(minimum)	.552	.690
r(medium)	.609	.739
r(maximum)	.853	.862
SVP		
r(minimum)	.724	.768
r(medium)	.739	.834
r(maximum)	.873	.925
STRENGTH		
r(minimum)	.435	.138
r(medium)	.594	.495
r(maximum)	.724	.705

[a] Reliabilities are calculated under three different assumptions about sources of error. See text for explanation.

[b] Reliabilities for the LOCATION factor could not be calculated separately for service and manufacturing occupations because there was no variation on this factor for the manufacturing occupations.

with those for manufacturing occupations. Although the addition of more raters and descriptions would raise the reliabilities for service occupations, the results of this analysis also suggest that other steps need to be taken. Additional training and practice in the rating of service occupations may be needed, or perhaps better guidelines and bench marks in the *Handbook* instructions. More fundamentally, the scales used to rate occupations for these characteristics may need to be adapted to the unique features of service jobs.

Analysis of the ratings of the remaining physical demands and environmental conditions requires a different approach. These variables are dichotomous and take on only one of two values, signifying either the presence or the absence of a given characteristic. To assess the reliability or consistency of ratings on these factors, two types of analyses were conducted. First, for each characteristic the modal or most frequently occurring rating was determined for each of the 24 DOT occupations. Consensus among raters was then calculated as the proportion of raters giving the modal response. If all raters agreed that a given characteristic was present, the proportion is 1.00, indicating perfect consensus. Table E-7 presents estimates of consensus obtained in this way.

The average consensus across jobs (last row of the table) varies considerably from scale to scale. Ratings are least consistent for TALK (.84) and SEE (.68). Except for these ratings, however, the overall proportion of agreement is quite high, at least .87 for NOISE, with a high of .96 for CLIMB.

A second feature of these results is that the poorest consensus among raters (lowest proportions) occurs disproportionately for occupations in the service category (top half of table). These results echo the finding that reliabilities are lower for service than for manufacturing occupations. A proportion of less than .80 (boldface in the table) occurs in 29 percent of the 144 rater-by-job combinations for the service jobs but in only 17 percent of the 144 combinations for manufacturing jobs.

To assess the consistency of individual raters in rating each factor, we calculated the correlation across all jobs between the rating of each rater and the average rating of all other raters. Since half of the raters rated the first set of job descriptions for the 24 occupations and half rated the second set, the two groups of raters were analyzed separately. Table E-8 gives the correlations of each rater with the average of the other 20 raters in his or her set. For raters who had no variance on the characteristic in question across all jobs (that is, raters who rated all jobs the same way on a given characteristic), this correlation could not be calculated. These ratings are denoted by asterisks in the table.

Results indicate that there is little problem with the consistency of ratings for CLIMB, TALK, and HAZARDS, as witnessed by the predominance of correlations of .80 and above. The low correlations for COLD, HEAT, WET, and ATMOSPHR are a result of the infrequency of a positive rating and do not necessarily reflect inconsistency. The low correlations for STOOP, REACH, SEE, and NOISE, on the other hand, are indicative of inconsistency among the raters, since these characteristics occur sufficiently often to compute a meaningful correlation.

Generally, these results suggest that in order to achieve a greater degree of consistency among raters, given the amount of information available in the description, ratings on all these dichotomous variables should be established by pooling the judgment of at least three or four raters (see the technical note at the end of this appendix). For the variables with the lowest degree of consistency, 8 or 10 raters would be needed to achieve stable and consistent responses. As mentioned previously, however, many analysts felt that the descriptions contained insufficient information with which to assign these particular ratings. Perhaps if additional information were incorporated into the description, higher levels of consistency would be achieved with the same, or only a slightly larger number of raters.

TECHNICAL NOTE

More precise estimates of the number of raters needed to increase alpha reliability to desired levels can be obtained using the following procedures: Coefficient alpha (α), the reliability (homogeneity) of a sum or average of k homogeneous items or raters, is given by

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} \sigma_i^2}{\sigma_T^2}\right),$$

where σ_i^2 is the variance of the ith item and σ_T^2 is the variance of the sum of k items. If we let $\bar{c}$ be the average intercovariance, $\bar{c}$ equals $\overline{r_{ij}\sigma_i\sigma_j}$. If we also let $\bar{v}$ be the average variance, then alpha can be written as

$$\alpha = \frac{k^2\bar{c}}{k(k-1)\bar{c} + k\bar{v}},$$

where

$$\sigma_T^2 = k(k-1)\bar{c} + k\bar{v}.$$

TABLE E-7 Rater Consensus by Occupation: Proportion of Modal Responses[a]

Occupation	CLIMB	STOOP	REACH	TALK	SEE	COLD	HEAT	WET	NOISE	HAZARDS	ATMOSPHR
Service											
1.	1.00	.76	.98	.62	.52	.98	.90	.90	.98	.88	1.00
2.	.98	.55	1.00	.57	.64	1.00	1.00	.90	.98	.86	1.00
3.	1.00	.98	.90	.55	.74	1.00	1.00	1.00	.81	1.00	.98
4.	1.00	1.00	.90	.74	.71	1.00	1.00	1.00	1.00	1.00	1.00
5.	1.00	1.00	.90	.86	.52	1.00	1.00	1.00	.98	.98	1.00
6.	.88	.52	.98	.83	.64	.95	.98	.52	.90	.83	.98
7.	1.00	1.00	.79	.71	.57	1.00	1.00	1.00	1.00	1.00	1.00
8.	1.00	1.00	.67	.76	.55	1.00	1.00	1.00	1.00	1.00	1.00
9.	1.00	1.00	.88	.90	.57	.98	.98	.98	.79	.98	1.00
10.	.64	.74	.67	.95	.86	.86	.57	.50	.60	.86	.60
11.	.98	1.00	.50	.90	.57	1.00	1.00	1.00	1.00	1.00	1.00
12.	.62	.69	.57	.90	.79	.88	.52	.52	.62	.79	.52

Manufacturing											
13.	1.00	1.00	.98	1.00	**.55**	1.00	.90	.90	1.00	.95	.98
14.	.98	**.76**	1.00	.86	**.62**	.98	.81	.83	.83	**.76**	.86
15.	1.00	.95	1.00	.98	**.71**	1.00	1.00	1.00	**.62**	.83	.81
16.	1.00	1.00	1.00	.90	**.79**	1.00	1.00	1.00	.88	.95	1.00
17.	1.00	.86	.98	1.00	**.55**	.98	.88	.88	.86	**.79**	.83
18.	1.00	.98	1.00	.98	**.74**	1.00	1.00	1.00	.98	.98	1.00
19.	1.00	1.00	1.00	1.00	**.74**	1.00	1.00	.93	1.00	**.79**	.88
20.	1.00	**.71**	.98	1.00	**.60**	1.00	1.00	.93	.90	.88	.98
21.	1.00	.95	.88	**.60**	.93	1.00	1.00	.83	.98	.93	.83
22.	1.00	.86	.93	.83	.83	1.00	1.00	1.00	**.64**	.81	.95
23.	1.00	.98	**.71**	.83	**.71**	1.00	1.00	.95	**.76**	.90	**.76**
24.	1.00	.88	.98	.86	.93	1.00	1.00	1.00	.88	.95	.90
Average proportion	.96	.88	.88	.84	**.68**	.98	.94	.90	.87	.90	.91

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[a] Proportions less than .80 are in boldface for easy identification.

TABLE E-8 Correlation of Raters With the Average of All Other Raters, Across Occupations by Job Description Set [a]

Rater	Characteristic										
	CLIMB	STOOP	REACH	TALK	SEE	COLD	HEAT	WET	NOISE	HAZARDS	ATMOSPHR
Set 1											
1.	.86	.67	*	.84	.11	*	.67	.66	*	.52	.50
2.	.83	.23	.15	.80	.32	*	*	*	*	.50	.81
3.	.86	*	.76	.57	*	*	*	.35	*	.09	*
4.	.87	.55	.42	.72	.23	*	*	*	*	.69	.81
5.	.86	.72	*	.65	*	.76	.84	.63	.55	.90	.59
6.	.83	.52	−.09	.30	.12	*	.84	.58	.27	.90	.81
7.	.87	.55	*	.83	*	.16	.90	.87	.43	.49	.62
8.	.86	.51	*	.80	*	.76	.81	.63	.37	.70	.72
9.	.87	.83	*	.90	*	*	.63	*	*	.67	.15
10.	.87	.72	.41	.77	−.19	.81	.52	.69	.76	.42	.58
11.	.83	.48	.52	.57	.21	*	.84	*	*	.64	.50
12.	.86	.23	.83	.93	.48	*	*	.57	*	.67	.13
13.	.86	*	.61	.92	.46	*	.18	.49	.48	.72	*
14.	.86	.72	.84	.92	.11	*	.16	.67	.19	.90	.39
15.	.86	.06	.10	.86	.16	*	*	*	.34	*	.90
16.	.83	*	.81	.80	.22	*	.74	.87	.43	.90	.81
17.	.83	.22	*	.84	.62	*	.84	.87	.66	.90	.81
18.	.28	.30	.44	.42	.27	*	.84	.58	.52	.90	−.14
19.	.83	.40	*	.77	.54	*	*	*	.39	.67	.48
20.	.86	.51	.78	.60	.56	*	.04	.20	.34	.03	.14
21.	.86	.58	*	.69	*	*	.26	.84	.44	.50	.78

α	.98	.86	.83	.97	.67	.62	.89	.89	.80	.92	.89
Set 2											
1.	.89	.39	.53	.70	.54	.72	.72	.69	.73	.93	.69
2.	.89	.51	.78	.76	.68	•	.98	.83	.60	.93	•
3.	.83	.51	•	.82	.67	•	.65	.56	•	.93	.89
4.	.83	.40	.55	.84	.45	•	•	•	.44	.76	.09
5.	.83	.51	.27	−.04	.29	•	•	.42	.58	.93	•
6.	.83	.51	•	.72	•	•	.98	•	.56	.93	•
7.	.83	.51	•	.84	•	•	.98	•	.38	.93	•
8.	.42	.17	•	.84	.68	•	•	.78	•	.93	.89
9.	•	•	.81	.58	.48	•	.98	.96	.60	.93	.89
10.	•	.31	.33	.75	.09	•	•	•	•	•	•
11.	.67	.66	.60	.76	.50	.58	.75	.83	.21	.58	.68
12.	.83	.61	.44	.85	.23	−.08	.41	−.05	.13	.37	.09
13.	.83	•	•	.89	.38	•	•	•	•	.93	•
14.	.80	.75	•	.84	.36	•	.98	.83	.21	.78	.66
15.	.83	.42	.61	.84	.36	•	.98	.78	.64	.70	.77
16.	.83	.48	•	.85	•	•	•	.27	•	•	−.03
17.	−.07	.30	.67	.61	.02	−.10	−.07	.02	.71	.20	.34
18.	.85	.83	.53	.62	•	•	.98	•	.21	.36	.82
19.	.80	•	.53	.54	.50	.72	.98	.78	•	.93	.89
20.	.89	.53	.48	.64	.65	•	.98	.78	.64	.51	.73
21.	.89	.51	.78	.84	.40	•	.98	.96	.86	.93	.89
α	.96	.86	.86	.96	.82	.47	.95	.90	.84	.95	.89

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[a] Correlations less than .80 are in boldface for easy identification.

• Correlation could not be computed because one variable had no variance.

It follows that

$$\alpha = \frac{k(\bar{c}/\bar{v})}{1 + (k - 1)(\bar{c}/\bar{v})} = \frac{k\bar{r}}{1 + (k - 1)\,\bar{r}}\ ,$$

where $\bar{r}$ equals $\bar{c}/\bar{v}$ and is the so-called intraclass coefficient of correlation (see Stanley, 1971:398). That is, the logic of alpha is exactly the same as the logic of the Spearman-Brown formula, with $\bar{r}$, the average interrater reliability, being stepped up, via Spearman-Brown, to alpha, the reliability of the average of k raters.

Thus to find $\bar{r}$ from alpha, we use formula 4.8 from Allen and Yen (1979), with our notation:

$$\bar{r} = \frac{(1/k)\alpha}{1 + (1/k - 1)\alpha} = \frac{\alpha}{k - (k - 1)\alpha}\ .$$

So, for example, if $\alpha = 0.98$ and $k = 21$,

$$\bar{r} = \frac{0.98}{21 - 20(0.98)} = 0.70.$$

Then we use formula 4.9 from Allen and Yen, with our notation, to see how many raters (k) we need to average in order to obtain a given reliability (α):

$$k = \left(\frac{\alpha}{1 - \alpha}\right)\left(\frac{1 - \bar{r}}{\bar{r}}\right).$$

For example, if $\alpha = 0.70$, but we want a reliability of 0.80 (a modest want),

$$k = \frac{0.8}{0.2}\left(\frac{1 - \bar{r}}{\bar{r}}\right) = 4.0\left(\frac{1 - 0.7}{0.7}\right) = 1.7.$$

Thus two raters would be needed to obtain a reliability of 0.80 given the initial value of alpha.

As a final illustration, suppose that we obtained $\alpha = 0.67$ with 21 raters. Then

$$\bar{r} = \frac{0.67}{21 - 20(0.67)} = 0.09.$$

The number of raters we would need to raise α from 0.67 to 0.80 is then

$$k = \left(\frac{0.8}{1 - 0.8}\right)\left(\frac{1 - 0.09}{0.09}\right) = 40.$$

APPENDIX

F

DOT Scales for the 1970 Census Classification

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To be able to relate the characteristics of occupations, as available in the DOT, to the characteristics of individuals in those occupations, as available in U.S. Census and survey data, would provide a tool for substantially increasing understanding of the operation of the U.S. economy. The need for this capability has been noted by a number of researchers, as documented in chapter 4, and was one underlying purpose of the development of the Standard Occupational Classification.

At present, the only available source of data on occupations is the aggregation of characteristics of occupational incumbents published every 10 years by the Census Bureau (e.g., U.S. Bureau of the Census, 1973). The occupational characteristics in the DOT constitute an additional rich source of data, particularly valuable because they measure aspects of job content rather than the characteristics of workers. To be most useful, however, the DOT occupational characteristics, which exist as scores for each of 12,099 occupations, must be mapped into whatever classification is used to code the occupations of individuals.

To illustrate the possibility of such a capability, we have estimated summary scores of selected DOT characteristics for the 591 occupational

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Thanks are due to Professor Jonathan Kelley for his advice on the construction of the factor-based scales.

categories in the 1970 Census. Table F-1 (at the end of this appendix) presents these scores for each of eight occupational characteristics in the fourth edition DOT: DATA, PEOPLE, THINGS, GED, SVP, STRENGTH, PHYSDEM (physical demands), and ENVIRON (environmental conditions).[1] Table F-2 (at the end of this appendix) provides scores for each of four factor-based scales derived from the DOT worker trait and worker function variables: substantive complexity, motor skills, physical demands, and undesirable working conditions.[2]

CENSUS SCORES FOR EIGHT DOT VARIABLES

To derive these scores, we took advantage of a source of data that includes both the 1970 U.S. Census occupation codes and the fourth edition DOT codes as well as enough cases to produce reliable estimates for detailed occupational categories. The April 1971 Current Population Survey (CPS), containing information for 60,441 workers, had been coded routinely with 1970 Census occupation codes. The occupational descriptions from this CPS had also been coded with third edition DOT codes by the staff of the occupational analysis field centers of the U.S. Employment Service. A map relating third to fourth edition DOT codes (created by the Division of Occupational Analysis) was used to add the fourth edition DOT occupational characteristics.[3] Fourth edition codes were not available for 6,984 cases.

To create scores for the census occupations, we averaged the DOT scores for all individuals in each census category. We did this by computing an average of the scores for all DOT occupations in each census occupation, with weights proportional to the number of individuals holding each DOT occupation.

Computing unweighted averages would in effect assume that each DOT title within a given census occupation occurs with equal frequency in the labor force. An illustation of the distortion that this would create can be found by considering the DOT occupations Bricklayer (861.381-018) and Stonemason (861.381-038), which combine (along with other DOT occupations) to form the census occupation Brickmasons and Stonemasons (410). It so happens that there are approximately 10 times as many bricklayers as stonemasons, as estimated by the representative sample of the Current Population Survey (bricklayers compose 70 percent of the category, and stonemasons compose 7 percent). With no weighting, both occupations would have equal weight in determining the occupational averages; weighting by the proportion of the sample in each of the two DOT titles means that the DOT occupation Bricklayer properly has the larger contribution to the average score for the census category.

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[1] These variables are discussed in greater detail in footnote *a* of Table F-1.

[2] A computer tape containing scores for the full set of fourth edition DOT occupational characteristics plus the four factor-based scales for the 1970 Census categories has been deposited with the National Technical Information Service and the Inter-University Consortium for Political and Social Research, University of Michigan.

[3] Lloyd Temme, then at the U.S. Bureau of the Census, made available to us the Current Population Survey containing codes for the fourth edition DOT. Earlier, Temme (1975) had performed a similar aggregation of third edition DOT codes into 1960 and 1970 Census occupational categories, using two Current Population Surveys (October 1966 and April 1971). Estimates for all third edition DOT characteristics for 595 1970 Census categories are available to interested users and may be obtained from Kenneth Spenner, Career Development, Boys Town Center for the Study of Youth Development, Boys Town, Nebraska 68010.

To create the occupational characteristic estimates provided in this appendix, we thus computed a weighted average of the scores for all the DOT occupations falling within any census category. The census classification used is not the standard three-digit code but the expanded version used in published reports (e.g., U.S. Bureau of the Census, 1973), which takes into account distinctions about industry and class of worker if such information is available.[4] Even with the large sample used in the aggregation, however, not all of the census occupational categories were represented in the CPS data. Thus the CPS data could not be used to provide estimates for 18 census occupations plus an unknown number of industrial distinctions within those occupational categories in which such distinctions are made. It was possible to assign scores to 17 of the census categories by borrowing scores from similar occupations or sets of occupations. Decision rules for these assignments are given in Table F-3 (at the end of this appendix).

CENSUS SCORES FOR FOUR FACTOR-BASED SCALES

Because, as we have seen in chapter 7, the DOT worker function and worker trait variables are highly redundant, with many items highly intercorrelated, it seemed desirable to develop multiple-item scales of the major underlying dimensions so as to improve reliability (Nunnally, 1967:191–198). To do this, we factor analyzed the 46 worker traits and worker functions by using as data the aggregated DOT scores for the 574 census occupational categories (categories for which scores had to be estimated were excluded from the analysis). This factor analysis is analogous but not identical to that reported in chapter 7, which is based on a 10-percent sample of the 12,099 DOT occupations. The two samples differ mainly in that the DOT sample includes proportionately more occupations in the production sector than does the census, as documented in chapter 7. The variables also differ slightly. For example, the working condition variables are coded as dichotomies in the DOT sample but as proportions in the census sample (the proportion of constituent DOT occupations having the condition). Nonetheless, the two samples are conceptually similar.

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[4] The expanded version of the 1970 U.S. Census occupational classification is described in greater detail in footnote *b* of Table F-1.

It is therefore reassuring that the factor analysis results obtained in this exercise[5] are not too dissimilar from those reported in chapter 7. Four interpretable factors emerged: substantive complexity, motor skills, physical demands, and undesirable working conditions. These correspond to factors 1, 2, 3, and 6 reported in chapter 7.

The next step was to choose for each factor that set of items that loaded strongly on the factor and only weakly or not at all on the other factors. The general rule of thumb used was that items should load at least .5 on the primary factor and less than .3 on the remaining factors. Items chosen in this way were then standardized and summed to form each scale, and, for convenience, each scale was converted to a 0–10 range (the lowest-scoring occupation is scored zero and the highest-scoring occupation is scored 10). This procedure gives all included items equal weight. The items included in each scale are shown below; the factor loadings from a reduced factor analysis including only the items appearing in one of the four scales are shown in Table F-4 (at the end of this appendix); and the scale scores for each census occupation are shown in Table F-2. (See Table 7-8 for a more complete description of these variables.) The four factor scales and items included in them are as follows: (1) substantive complexity, including DATA (worker function), GED (training time), SVP (training time), INTELL (aptitude), VERBAL (aptitude), NUMER (aptitude), ABSTRACT (interest), and REPCON (temperament for repetitive or continuous process); (2) motor skills, including THINGS (worker function), MOTOR (aptitude), FINGDEX (aptitude), MANDEX (aptitude), COLORDIS (aptitude), and SEE (physical demand), and (3) physical demands, including EYEHAND (aptitude), CLIMB (physical demand), STOOP (physical demand), LOCATION (working condition), and HAZARDS (working condition), and (4) undesirable working conditions, including COLD (working condition), HEAT (working condition), and WET (working condition).

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[5] The factor analysis was carried out using the SPSS computer program: the procedures used were principal components with iterations, varimax rotation, and default options.

TABLE F-1 Worker Function and Selected Worker Trait Scores for 1970 U.S. Census Occupational Categories[a]

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
0010000	Accountants	1.4	6.2	5.7	4.8	7.3	1.0	0.4	0.0
0020000	Architects	0.3	6.0	1.3	5.8	7.9	1.9	1.9	0.1
0030000	Computer programmers	1.2	6.0	3.9	5.1	7.1	1.1	1.1	0.0
0040000	Computer systems analysts	1.0	6.0	6.3	5.3	7.0	1.0	1.0	0.0
0050000	Computer specialists, n.e.c.	0.8	3.7	7.0	5.2	7.2	1.3	1.0	0.0
0060000	Aeronautical and astronautical engineers	0.5	5.8	1.8	5.4	7.8	1.7	1.8	0.3
0100000	Chemical engineers	0.6	6.0	1.7	5.7	7.8	2.0	1.8	0.2
0110000	Civil engineers	0.2	6.0	1.3	4.9	7.9	2.0	2.0	0.1
0120000	Electrical and electronic engineers	0.4	6.0	2.0	5.1	7.9	1.9	1.9	0.1
0130000	Industrial engineers	0.9	5.8	6.0	5.2	7.3	1.4	1.1	0.1
0140000	Mechanical engineers	0.3	5.9	1.4	5.0	7.8	1.9	2.0	0.2
0150000	Metallurgical and materials engineers	0.2	6.0	2.3	5.2	7.7	1.9	1.8	0.0
0200000	Mining engineers	0.0	6.0	1.0	5.3	8.0	2.0	2.7	2.0
0210000	Petroleum engineers	0.1	6.0	1.7	5.4	7.9	1.8	1.4	0.0
0220000	Sales engineers	1.5	5.3	4.6	4.7	7.1	1.8	0.9	0.0
0230000	Engineers, n.e.c.	0.5	6.0	2.4	5.2	7.7	1.6	1.6	0.1
0240000	Farm management advisors	1.0	2.6	5.2	4.9	6.9	2.1	0.7	0.0
0250000	Foresters and conservationists	2.3	6.4	4.3	3.9	5.7	3.0	2.5	1.0
0260000	Home management advisors	1.4	2.0	4.6	5.2	7.4	2.0	0.8	0.0
0300000	Judges	1.0	0.0	7.0	6.0	9.0	1.0	0.0	0.0
0310000	Lawyers	1.1	0.4	7.0	5.9	7.9	1.0	0.0	0.0
0320000	Librarians	1.5	4.2	7.0	4.5	6.4	2.2	1.2	0.1
0330000	Archivists and curators	1.5	5.3	5.5	4.7	7.0	2.0	1.3	0.5
0340000	Actuaries	1.1	6.0	7.0	5.0	7.9	1.0	0.7	0.0
0350000	Mathematicians	0.3	6.0	7.0	5.8	7.8	1.0	1.5	0.0
0360000	Statisticians	0.9	6.1	6.6	5.0	6.9	1.1	1.0	0.0
0420000	Agricultural scientists	1.6	5.2	3.4	5.0	6.8	2.4	2.3	0.3

0430000	Atmospheric and space scientists	0.6	6.0	3.6	4.7	6.7	1.3	1.0	0.0
0440000	Biological scientists	0.4	6.1	1.3	5.8	7.7	1.8	2.0	0.2
0450000	Chemists	0.2	6.0	1.1	5.8	7.8	2.0	1.9	0.1
0510000	Geologists	0.0	6.0	1.0	6.0	8.0	2.0	3.9	0.9
0520000	Marine scientists	0.0	6.0	1.0	6.0	8.0	2.0	2.0	0.0
0530000	Physicists and astronomers	0.1	5.6	2.1	5.9	8.0	1.8	1.8	0.1
0540000	Life and physical scientists, n.e.c.	0.0	6.0	7.0	5.0	7.0	1.0	1.0	0.0
0550000	Operations and systems researchers and analysts	1.3	6.0	6.3	4.9	6.8	1.1	1.0	0.0
0560000	Personnel and labor relations workers	1.5	3.9	6.7	4.8	6.5	1.2	0.4	0.0
0610000	Chiropractors	1.0	0.0	1.0	5.0	7.0	3.0	2.0	0.0
0620000	Dentists	1.0	0.3	1.0	5.9	7.9	1.1	2.0	0.0
0630000	Optometrists	1.0	0.0	1.0	5.0	7.0	1.0	2.0	0.0
0640000	Pharmacists	1.0	6.0	1.6	4.9	7.0	1.9	1.8	0.0
0650000	Physicians, medical and osteopathic	1.0	0.5	1.4	5.9	7.9	2.0	1.9	0.1
0710000	Podiatrists	1.0	0.2	1.7	5.0	7.0	2.1	1.9	0.0
0720000	Veterinarians	1.1	2.2	1.4	4.8	7.7	2.7	2.0	1.0
0730000	Health practitioners, n.e.c.	1.0	0.0	1.0	5.0	7.0	3.0	2.0	0.0
0740000	Dietitians	1.0	2.9	6.8	5.0	6.8	2.0	1.0	0.0
0750000	Registered nurses	2.8	6.5	4.1	4.9	6.9	2.9	2.0	0.0
0760000	Therapists	1.7	2.9	3.0	4.7	6.6	2.0	2.0	0.3
0800000	Clinical laboratory technologists and technicians	3.0	6.8	1.2	4.8	6.0	2.1	2.0	0.1
0810000	Dental hygienists	3.0	6.3	1.0	4.0	6.2	2.0	1.9	0.0
0820000	Health record technologists and technicians	2.4	6.0	7.0	4.9	6.3	2.2	1.1	0.1
0830000	Radiologic technologists and technicians	2.9	5.8	1.8	4.8	5.8	2.7	2.0	1.0
0840000	Therapy assistants	2.9	6.3	2.2	4.6	6.0	2.2	1.9	0.3
0850000	Health technologists and technicians, n.e.c.	2.7	6.0	3.8	4.2	6.0	2.1	1.7	0.4
0860000	Clergymen	0.0	0.0	7.0	6.0	8.0	2.0	0.0	0.0
0900000	Religious workers, n.e.c.	1.1	1.5	6.6	5.3	7.4	1.7	0.4	0.0

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
0910000	Economists	1.0	5.5	6.7	4.9	6.9	1.3	1.0	0.0
0920000	Political scientists	1.3	3.8	7.0	4.7	6.4	1.3	0.9	0.0
0930000	Psychologists	1.0	1.5	6.6	5.9	7.9	1.4	0.8	0.0
0940000	Sociologists	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
0950000	Urban and regional planners	1.0	6.0	5.9	5.2	7.8	1.4	0.8	0.2
0960000	Social scientists, n.e.c.	0.4	5.4	7.0	5.6	7.1	1.6	1.3	0.0
1000000	Social workers	1.1	1.4	6.9	4.9	6.9	1.2	0.2	0.0
1010000	Recreation workers	1.3	2.9	6.8	4.8	7.0	1.8	0.8	0.0
1020000	Agriculture teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
1030000	Atmospheric, earth, marine, and space teachers	1.3	3.3	5.0	6.0	8.0	2.0	1.3	0.0
1040000	Biology teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.2	0.0
1050000	Chemistry teachers	1.9	2.3	6.6	6.0	8.0	2.0	0.3	0.0
1100000	Physics teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.4	0.0
1110000	Engineering teachers	1.9	2.4	6.7	6.0	8.0	2.0	0.3	0.0
1120000	Mathematics teachers	2.0	2.0	7.0	5.9	7.9	2.0	0.0	0.0
1130000	Health specialties teachers	1.9	2.5	6.3	5.6	7.6	1.8	0.2	0.0
1140000	Psychology teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
1150000	Business and commerce teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
1160000	Economics teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.2	0.0
1200000	History teachers	1.9	2.2	7.0	5.8	7.8	1.9	0.0	0.0
1210000	Sociology teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
1220000	Social science teachers, n.e.c.	1.9	2.3	7.0	6.0	8.0	1.9	0.0	0.0
1230000	Art, drama, and music teachers	1.2	2.2	5.0	5.5	7.9	2.0	0.8	0.0
1240000	Coaches and physical education teachers	2.0	2.0	6.6	5.3	7.9	2.4	1.6	0.0
1250000	Education teachers	2.0	2.0	7.0	5.9	7.9	2.0	0.0	0.0
1260000	English teachers	2.0	2.2	6.8	5.7	7.7	2.0	0.2	0.0

1300000	Foreign language teachers	2.0	2.0	7.0	5.6	7.6	2.0	0.0	0.0
1310000	Home economics teachers	1.6	2.0	4.9	5.6	7.6	2.0	0.7	0.0
1320000	Law teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
1330000	Theology teachers	2.0	2.0	7.0	6.0	8.0	2.0	0.0	0.0
1340000	Trade, industrial, and technical teachers	2.0	2.0	7.0	4.4	7.2	2.0	0.8	0.0
1350000	Miscellaneous teachers, college and university	2.0	2.0	7.0	6.0	8.0	2.0	0.1	0.0
1400000	Teachers, college and university, subject not specified	2.0	2.3	6.7	5.7	7.7	2.0	0.5	0.0
1410000	Adult education teachers	2.0	2.1	6.6	4.8	6.9	2.0	0.4	0.0
1420000	Elementary school teachers	2.0	2.0	6.9	5.0	6.1	2.0	0.1	0.0
1430000	Prekindergarten and kindergarten teachers	3.1	3.5	6.8	4.4	5.9	2.2	0.6	0.3
1440000	Secondary school teachers	1.9	2.0	6.5	5.0	7.0	2.0	0.3	0.0
1450000	Teachers, except college and university, n.e.c.	0.9	2.2	3.8	4.9	7.3	1.9	1.6	0.1
1500000	Agriculture and biological technicians	2.4	6.4	2.3	4.1	5.4	2.3	1.8	0.7
1510000	Chemical technicians	2.3	6.5	1.8	4.3	5.9	2.0	2.0	0.7
1520000	Draftsmen	1.8	7.2	1.1	4.8	6.9	1.2	2.0	0.0
1530000	Electrical and electronic engineering technicians	1.5	6.3	1.5	4.4	6.8	2.0	2.0	0.1
1540000	Industrial engineering technicians	3.0	7.0	5.1	4.1	5.6	1.7	1.7	0.0
1550000	Mechanical engineering technicians	2.0	6.8	0.8	4.6	6.2	2.2	2.0	0.0
1560000	Mathematical technicians	1.0	6.0	2.0	5.0	7.0	1.0	1.0	0.0
1610000	Surveyors	1.2	6.1	6.7	4.8	6.8	2.0	2.8	0.0
1620000	Engineering and science technicians, n.e.c.	2.1	6.1	2.4	4.4	6.1	1.9	1.9	0.3
1630000	Airplane pilots	2.1	5.9	3.2	4.9	6.8	2.0	2.0	2.1
1640000	Air traffic controllers	1.1	6.1	2.4	4.0	7.6	1.7	1.7	0.0
1650000	Embalmers	1.6	6.3	5.1	4.0	7.0	2.6	2.3	0.6
1700000	Flight engineers	2.0	6.0	1.0	4.0	7.0	2.0	3.0	1.0
1710000	Radio operators	2.4	6.0	2.7	3.5	5.0	1.2	1.3	0.1

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
1720000	Tool programers, numerical control	1.9	6.0	6.1	4.6	7.3	1.4	1.2	0.2
1730000	Technicians, n.e.c.	2.2	6.1	2.8	4.3	5.4	2.0	1.7	0.0
1740000	Vocational and educational counselors	1.2	1.0	7.0	5.1	7.0	1.8	1.3	0.0
1750000	Actors	1.1	4.1	6.0	4.5	6.6	2.0	0.7	0.2
1800000	Athletes and kindred workers	2.3	2.9	5.5	4.0	7.3	3.1	3.2	0.3
1810000	Authors	0.6	6.2	7.0	5.7	7.6	1.0	0.6	0.0
1820000	Dancers	0.0	4.0	7.0	4.0	7.0	2.0	3.0	0.0
1830000	Designers	0.8	6.2	1.8	4.8	7.1	1.6	1.8	0.1
1840000	Editors and reporters	0.5	4.5	6.8	5.4	7.6	1.0	1.2	0.0
1850000	Musicians and composers	0.0	4.0	2.6	4.9	8.0	2.0	1.7	0.7
1900000	Painters and sculptors	0.6	6.0	1.2	4.8	7.1	1.3	1.9	0.0
1910000	Photographers	0.5	6.1	2.2	4.0	6.8	2.0	2.0	0.1
1920000	Public relations men and publicity writers	0.3	6.0	6.7	5.0	7.1	1.0	0.8	0.0
1930000	Radio and television announcers	1.2	4.3	7.0	5.0	6.1	1.0	0.2	0.0
1940000	Writers, artists, and entertainers, n.e.c.	1.7	4.5	5.5	4.8	6.9	1.5	1.5	0.2
1950000	Research workers, not specified	1.8	4.1	5.3	5.2	7.2	1.9	1.2	0.1
2010000	Assessors, controllers, and treasurers; local public administration	1.1	4.7	6.8	4.9	7.1	1.7	1.3	0.0
2020000	Bank officers and financial managers	1.3	2.6	6.7	4.9	7.7	1.1	0.4	0.0
2030000	Buyers and shippers, farm products	1.3	4.4	7.0	4.5	6.7	2.0	0.6	0.3
2050000	Buyers, wholesale and retail trade	1.2	5.1	6.9	4.0	6.2	1.7	1.2	0.0
2100000	Credit men	1.2	5.8	6.9	4.9	7.6	1.0	0.0	0.0
2110000	Funeral directors	1.2	6.0	7.0	3.9	6.8	2.1	2.0	0.0
2120000	Health administrators	1.1	2.5	6.3	4.9	7.5	1.8	0.6	0.1
2130000	Construction inspectors, public administration	1.2	6.0	6.6	4.8	6.8	2.0	2.9	0.2

	Inspectors, except construction, public administration								
2159170	Federal administration and postal service	2.5	6.5	5.7	4.1	5.9	2.2	2.0	0.6
2159270	State public administration	2.2	6.3	6.3	3.9	5.2	2.0	1.8	0.4
2159370	Local public administration	2.2	6.0	5.5	4.0	5.3	2.5	2.5	0.5
2160000	Managers and superintendents, building	1.4	5.3	6.7	3.7	6.4	2.1	0.9	0.1
2200000	Office managers, n.e.c.	1.1	5.8	6.9	4.1	7.0	1.1	0.1	0.0
2210000	Officers, pilots, and pursers; ship	1.5	3.9	3.6	4.0	7.1	2.4	2.7	1.0
	Officials and administrators, public administration, n.e.c.								
2229170	Federal administration and postal service	1.3	4.1	6.6	4.8	7.2	1.3	0.4	0.0
2229270	State public administration	1.5	4.9	6.8	4.5	6.4	1.9	1.3	0.4
2229370	Local public administration	1.7	4.9	6.2	4.5	6.5	1.4	0.9	0.2
2230000	Officials of lodges, societies, and unions	1.1	4.4	6.7	4.9	7.7	1.1	0.2	0.0
2240000	Postmasters and mail superintendents	1.0	5.5	7.0	4.0	6.8	1.2	0.0	0.0
2250000	Purchasing agents and buyers, n.e.c.	1.1	4.7	7.0	4.1	6.7	1.2	0.3	0.0
2260000	Railroad conductors	1.8	5.9	6.9	3.8	7.2	2.2	2.6	1.0
2300000	Restaurant, cafeteria, and bar managers	1.3	5.9	6.6	3.9	6.6	1.9	1.5	0.0
2310000	Sales managers and department heads, retail trade	1.1	4.6	6.9	4.2	6.6	1.6	0.2	0.0
2330000	Sales managers, except retail trade	1.1	5.3	6.9	4.9	7.7	1.1	0.1	0.0
2350000	School administrators, college	1.4	3.2	6.7	5.0	7.6	1.3	0.2	0.0
2400000	School administrators, elementary and secondary	1.2	1.4	6.8	5.0	7.9	1.2	0.2	0.0
	Managers and administrators, n.e.c.								
2450990	Construction, salaried	1.1	4.9	6.1	4.6	7.6	1.8	0.7	0.4
2450991	Construction, self-employed	1.7	6.2	5.4	3.9	6.9	2.3	1.6	1.0
2452990	Tobacco manufactures, salaried	1.1	3.0	6.2	4.9	7.7	1.5	0.4	0.1
2452991	Tobacco manufactures, self-employed	1.6	3.7	5.4	4.5	7.3	1.7	0.8	0.2

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
2453990	Manufacturing, nondurable goods, salaried	1.0	2.7	6.5	5.0	7.8	1.5	0.3	0.0
2453991	Manufacturing, nondurable goods, self-employed	1.9	4.7	5.1	4.4	6.7	1.8	0.8	0.4
2454390	Transportation, salaried	1.3	4.6	6.6	4.5	7.3	1.3	0.3	0.1
2454391	Transportation, self-employed	2.7	5.3	5.5	3.9	6.0	2.0	1.2	0.4
2454990	Communications, and utilities and sanitary services, salaried	1.0	4.9	6.2	4.8	7.5	1.4	0.5	0.1
2454991	Communications, and utilities and sanitary services, self-employed	3.7	6.0	4.9	3.5	4.6	2.3	1.3	0.5
2455990	Wholesale trade, salaried	1.1	4.2	6.8	4.7	7.4	1.3	0.4	0.0
2455991	Wholesale trade, self-employed	1.3	5.4	6.7	4.3	6.8	1.4	0.9	0.0
	Retail trade								
2456070	Lumber and building material, salaried	1.2	5.2	6.9	4.2	6.9	1.3	0.2	0.0
2456071	Lumber and building material, self-employed	1.2	6.0	6.8	4.0	6.9	1.2	0.2	0.0
2456090	Department and mail order establishments, salaried	1.2	5.3	6.9	4.2	6.7	1.3	0.2	0.0
2456091	Department and mail order establishments, self-employed	1.1	5.7	6.9	4.1	7.0	1.1	0.0	0.0
2456280	Grocery stores, salaried	1.1	5.8	6.9	4.0	6.9	1.1	0.1	0.0
2456281	Grocery stores, self-employed	1.4	6.1	6.8	3.9	6.6	1.3	0.3	0.0
2456390	Motor vehicle dealers, salaried	1.4	5.4	6.3	4.2	6.8	1.5	0.7	0.0
2456391	Motor vehicle dealers, self-employed	1.4	5.6	6.2	4.1	6.7	1.3	0.3	0.1
2456480	Gasoline service stations, salaried	2.0	5.9	6.5	3.7	5.8	1.8	0.9	0.2

2456481	Gasoline service stations, self-employed	2.0	6.0	6.6	3.7	5.7	1.8	0.9	0.1
2456570	Apparel and accessories stores (except shoes), salaried	1.2	5.7	6.9	4.1	6.9	1.1	0.2	0.0
2456571	Apparel and accessories stores (except shoes), self-employed	1.4	5.8	6.3	4.0	6.8	1.2	0.3	0.0
2456670	Furniture and home furnishings stores, salaried	1.1	5.5	7.0	4.2	7.1	1.0	0.0	0.0
2456671	Furniture and home furnishing stores, self-employed	1.5	5.7	6.3	4.0	6.8	1.4	0.4	0.1
2456990	Other retail trade, salaried	1.1	5.8	6.8	4.1	6.9	1.1	0.1	0.0
2456991	Other retail trade, self-employed	1.2	5.9	6.8	4.0	6.7	1.2	0.3	0.0
2457190	Finance, insurance, and real estate, salaried	1.4	4.3	6.9	4.7	7.2	1.3	0.2	0.0
2457191	Finance, insurance, and real estate, self-employed	1.7	5.1	6.4	4.5	6.8	1.8	0.6	0.2
2457270	Advertising, salaried	1.3	3.8	6.0	4.5	7.1	1.4	0.6	0.2
2457271	Advertising, self-employed	1.5	5.3	4.9	4.1	6.9	1.8	1.1	0.4
2457990	Personal services, salaried	1.2	3.4	6.7	4.2	6.9	2.1	0.7	0.2
2457991	Personal services, self-employed	1.8	4.6	6.6	3.9	6.4	1.9	0.7	0.3
2459980	All other industries, salaried	1.2	3.5	6.5	4.7	7.4	1.6	0.4	0.1
2459981	All other industries, self-employed	1.8	4.4	6.3	4.3	6.6	2.0	0.9	0.4
2600000	Advertising agents and salesmen	2.6	4.9	6.8	4.2	6.2	1.8	0.1	0.0
2610000	Auctioneers	2.0	5.0	7.0	3.0	6.0	2.0	2.0	0.0
2620000	Demonstrators	2.9	5.2	5.6	3.5	3.7	1.9	1.0	0.0
2640000	Hucksters and peddlers	3.0	5.1	6.9	3.2	3.3	2.0	0.6	0.0
2650000	Insurance agents, brokers, and underwriters	1.9	5.2	6.9	4.2	6.1	1.8	0.1	0.0
2660000	Newsboys	4.0	5.1	6.9	2.0	2.1	2.0	1.0	0.0
2700000	Real estate agents and brokers	3.0	5.0	6.9	4.0	4.9	2.0	1.0	0.0
2710000	Stock and bond salesmen	1.2	5.1	6.7	4.9	6.8	1.2	0.8	0.1
2800000	Salesmen and sales clerks, n.e.c.	3.2	5.6	6.6	3.7	4.2	2.0	0.9	0.0

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
2810000	Sales representatives, manufacturing industries	2.7	5.1	6.8	4.0	5.1	2.0	0.3	0.0
2820000	Sales representatives, wholesale trade	2.9	5.1	6.8	3.9	5.0	2.0	0.3	0.0
2830000	Sales clerks, retail trade	3.4	5.9	6.8	3.5	3.6	2.0	1.2	0.0
2840000	Salesmen, retail trade	3.0	5.2	5.5	3.9	4.7	2.1	1.1	0.0
2850000	Salesmen of services and construction	3.0	5.5	6.2	3.7	4.7	1.9	0.8	0.0
3010000	Bank tellers	3.0	6.0	2.1	4.0	5.0	2.0	2.0	0.0
3030000	Billing clerks	3.2	7.6	2.3	3.1	3.9	1.1	1.9	0.0
3050000	Bookkeepers	3.1	7.8	2.2	4.0	4.8	1.0	1.9	0.0
3100000	Cashiers	3.9	6.0	2.5	3.1	3.0	2.1	1.9	0.0
3110000	Clerical assistants, social welfare	3.6	6.0	3.1	3.6	3.8	1.8	1.7	0.0
3120000	Clerical supervisors, n.e.c.	1.4	5.4	5.7	4.2	6.5	1.3	0.5	0.0
3130000	Collectors, bill and account	2.9	5.5	7.0	3.6	4.2	1.9	0.0	0.0
3140000	Counter clerks, except food	3.9	6.6	5.4	2.9	3.4	1.9	0.9	0.1
3150000	Dispatchers and starters, vehicle	1.9	5.7	6.2	3.3	4.7	1.2	0.8	0.1
3200000	Enumerators and interviewers	2.7	5.6	5.8	3.5	4.0	1.8	1.6	0.0
3210000	Estimators and investigators, n.e.c.	2.5	5.8	6.1	4.0	5.2	1.3	0.8	0.0
3230000	Expediters and production controllers	2.4	6.6	5.6	3.7	5.0	1.7	1.4	0.2
3250000	File clerks	3.1	6.4	4.1	3.2	4.0	1.9	1.9	0.0
3260000	Insurance adjusters, examiners, and investigators	2.0	2.8	7.0	4.8	5.9	1.7	0.2	0.0
3300000	Library attendants and assistants	3.1	6.2	6.8	3.2	4.3	2.7	1.9	0.0
3310000	Mail carriers, post office	3.1	6.0	6.7	3.0	2.9	2.9	2.0	0.0
3320000	Mail handlers, except post office	4.4	7.3	6.8	3.0	2.8	2.1	1.6	0.0
3330000	Messengers and office boys	5.4	6.5	6.8	2.2	2.2	2.2	1.3	0.0
3340000	Meter readers, utilities	5.0	6.0	7.0	3.0	4.0	2.0	2.0	0.0

3410000	Bookkeeping and billing machine operators	3.2	7.8	2.5	3.5	4.4	1.2	2.0	0.3
3420000	Calculating machine operators	4.0	7.8	2.0	2.9	3.1	1.0	2.0	0.0
3430000	Computer and peripheral equipment operators	2.9	6.1	2.3	4.1	5.9	1.9	1.9	0.0
3440000	Duplicating machine operators	5.5	7.5	3.5	2.4	2.9	2.0	1.5	0.0
3450000	Key punch operators	4.2	7.2	2.1	3.4	3.9	1.2	1.9	0.0
3500000	Tabulating machine operators	5.3	7.7	4.2	2.7	4.0	1.9	1.7	0.0
3550000	Office machine operators, n.e.c.	4.3	7.6	2.7	3.1	4.0	1.8	1.6	0.5
3600000	Payroll and timekeeping clerks	3.6	7.3	3.3	3.1	3.9	1.0	1.9	0.0
3610000	Postal clerks	3.4	6.3	6.7	3.7	3.8	2.7	1.9	0.0
3620000	Proofreaders	3.4	7.8	7.0	3.9	5.1	1.7	2.0	0.0
3630000	Real estate appraisers	2.0	6.0	7.0	5.0	7.0	2.0	3.0	0.0
3640000	Receptionists	3.0	6.0	6.4	3.1	5.0	1.1	1.0	0.0
3700000	Secretaries, legal	3.0	6.1	2.1	4.0	6.0	1.0	2.0	0.0
3710000	Secretaries, medical	3.0	5.9	2.1	3.9	6.6	1.1	1.9	0.0
3720000	Secretaries, n.e.c.	3.0	6.0	2.1	4.0	6.0	1.0	2.0	0.0
3740000	Shipping and receiving clerks	3.2	7.6	6.9	3.0	4.8	2.8	1.9	0.0
3750000	Statistical clerks	3.2	7.0	3.7	3.5	4.3	1.5	1.8	0.0
3760000	Stenographers	3.0	6.0	2.0	3.1	5.0	1.0	2.0	0.0
3810000	Stock clerks and storekeepers	3.4	7.4	6.8	3.0	4.0	3.1	1.8	0.1
3820000	Teacher aides, except school monitors	2.7	4.7	6.9	3.7	4.4	1.4	0.2	0.0
3830000	Telegraph messengers	5.4	6.5	6.8	2.2	2.2	2.2	1.3	0.0
3840000	Telegraph operators	4.6	6.4	2.4	3.5	4.3	1.2	1.7	0.0
3850000	Telephone operators	4.8	5.8	2.3	3.1	3.3	1.4	1.5	0.0
3900000	Ticket, station, and express agents	2.7	5.7	6.7	3.7	4.9	1.9	0.9	0.2
3910000	Typists	3.7	6.6	2.0	3.0	3.8	1.1	2.0	0.0
3920000	Weighers	4.8	7.7	6.3	2.4	2.7	2.8	1.4	0.5
	Miscellaneous clerical workers								
3943980	Manufacturing industries	3.9	6.3	2.9	3.4	3.4	1.9	1.9	0.0
3944980	Transportation, communications, and other public utilities	3.5	5.9	3.9	3.5	3.8	1.7	1.5	0.0

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
3945980	Wholesale trade	4.1	6.3	3.7	3.3	3.1	1.8	1.6	0.0
3947190	Finance, insurance, and real estate	3.6	6.3	3.2	3.6	3.8	1.6	1.7	0.0
3948980	Professional and related services	3.6	6.0	3.1	3.6	3.8	1.8	1.7	0.0
3949390	Public administration	3.6	6.3	3.3	3.5	3.6	1.7	1.7	0.0
3949980	Other miscellaneous clerical workers	3.9	6.3	3.5	3.3	3.4	1.8	1.6	0.0
3950000	Not specified clerical workers	3.8	6.2	3.4	3.5	3.5	1.8	1.7	0.0
4010000	Automobile accessories installers	3.1	5.4	3.8	3.7	6.0	2.7	1.7	0.3
4020000	Bakers	3.3	7.7	1.6	3.0	6.4	3.5	1.4	0.4
4030000	Blacksmiths	3.0	8.0	1.0	3.8	6.8	3.8	2.2	2.5
4040000	Boilermakers	2.1	6.3	1.0	3.8	6.8	3.7	3.9	1.8
4050000	Bookbinders	4.0	8.0	2.0	2.7	6.0	2.1	1.8	0.3
4100000	Brickmasons and stonemasons	3.0	7.8	1.4	3.1	7.6	3.2	3.7	1.2
4110000	Brickmasons and stonemasons, apprentices	3.0	8.0	1.0	3.0	8.0	3.0	4.0	1.0
4120000	Bulldozer operators	6.0	7.8	3.0	3.0	4.4	3.3	3.2	1.6
4130000	Cabinetmakers	2.6	8.0	0.8	3.8	5.8	2.9	2.2	0.3
4150000	Carpenters	3.0	7.8	1.2	3.9	6.9	3.1	3.9	1.9
4160000	Carpenter apprentices	3.1	7.7	1.6	4.0	6.8	3.1	3.9	1.8
4200000	Carpet installers	3.3	7.9	1.6	3.0	6.6	3.9	2.9	0.0
4210000	Cement and concrete finishers	3.3	6.3	3.8	3.0	5.8	3.1	3.9	1.9
4220000	Compositors and typesetters	[illegible]	7.4	1.9	3.8	7.0	2.6	2.0	0.6
4230000	Printing trades apprentices, except pressmen	3.3	8.0	1.3	3.7	7.3	2.3	2.0	0.7
4240000	Cranemen, derrickmen, and hoistmen	5.9	6.6	3.0	2.9	4.6	2.4	2.3	1.5
4250000	Decorators and window dressers	0.3	6.8	1.4	4.2	6.0	2.2	2.2	0.9
4260000	Dental laboratory technicians	2.9	7.7	1.3	4.0	7.4	1.9	1.9	0.0
4300000	Electricians	2.1	6.2	1.2	4.0	6.9	2.9	3.7	1.0

4310000	Electrician apprentices	2.0	6.1	1.0	4.0	7.0	3.0	4.0	1.0
4330000	Electric power linemen and cablemen	2.7	6.4	1.2	3.9	6.9	3.2	3.2	0.8
4340000	Electrotypers and stereotypers	3.0	7.2	1.8	4.0	6.9	2.5	2.0	0.7
4350000	Engravers, except photoengravers	3.6	8.0	1.6	3.2	6.6	1.9	2.2	0.4
4360000	Excavating, grading, and road machine operators; except bulldozer	5.9	7.7	3.1	3.5	5.3	2.9	2.6	1.7
4400000	Floor layers, except tile setters	4.8	7.2	2.2	3.0	5.2	3.4	3.4	1.2
	Foremen, n.e.c.								
4410990	Construction	1.1	4.0	4.3	4.2	7.4	2.2	1.8	1.1
4411390	Blast furnaces, steel works, rolling and finishing mills	1.1	4.0	3.2	4.3	7.4	2.3	1.3	1.1
4411770	Engines and turbines	1.0	3.8	2.7	4.3	7.5	2.1	1.4	0.7
4411990	Household appliances	1.3	3.8	3.2	4.2	7.1	2.1	1.4	0.4
4412190	Motor vehicles and motor vehicle equipment	1.2	4.1	4.0	4.2	7.2	2.1	1.7	0.7
4412590	Other durable goods	1.1	3.5	3.1	4.2	7.5	2.0	1.3	0.3
4412680	Meat products	1.2	3.3	4.4	4.0	6.5	2.1	1.2	0.5
4413070	Knitting mills	2.1	4.2	3.6	4.0	6.4	2.0	1.6	0.4
4413980	Other nondurable goods	1.2	3.7	3.8	4.1	7.0	2.0	1.4	0.6
4414390	Transportation	1.3	4.2	5.7	4.0	6.9	2.2	1.4	0.3
4414990	Communications, and utilities and sanitary services	1.1	4.0	4.8	4.1	7.2	2.0	1.7	0.4
4415980	Wholesale trade	1.2	3.9	5.6	4.1	6.8	2.0	1.1	0.3
4419980	All other industries	1.2	3.9	4.7	4.1	7.0	2.3	1.6	0.7
4420000	Forgemen and hammermen	4.5	6.3	2.5	3.1	5.6	3.5	2.2	2.9
4430000	Furniture and wood finishers	3.9	8.0	2.3	3.4	5.7	2.3	2.9	0.8
4440000	Furriers	2.0	6.0	1.0	4.0	8.0	2.0	2.0	1.0
4450000	Glaziers	3.5	7.9	1.9	3.1	6.2	2.9	3.4	1.7
4460000	Heat treaters, annealers, and temperers	5.1	7.4	2.6	3.2	4.4	2.7	1.6	2.6
4500000	Inspectors, scalers, and graders; log and lumber	4.8	8.0	7.0	2.9	4.0	2.1	2.5	1.0

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
	Inspectors, n.e.c.								
4520990	Construction	1.9	6.1	5.8	4.1	6.4	2.1	3.5	1.3
4524070	Railroads and railway express service	3.9	7.0	7.0	3.1	4.5	2.6	2.4	0.4
4529990	All other industries	3.1	6.8	5.2	3.4	5.4	2.6	2.2	1.1
4530000	Jewelers and watchmakers	2.0	8.0	1.0	4.0	7.6	1.0	2.0	0.0
4540000	Job and die setters, metal	3.1	7.1	0.3	3.8	6.2	3.0	2.5	1.4
4550000	Locomotive engineers	2.8	6.1	2.8	4.0	7.0	2.0	2.0	1.0
4560000	Locomotive firemen	2.9	6.1	2.8	4.0	7.0	2.1	2.1	1.0
4610000	Machinists	2.1	7.8	0.2	4.0	7.0	3.1	2.9	1.0
4620000	Machinist apprentices	2.7	7.8	0.6	3.9	6.6	2.9	3.0	1.2
4700000	Air conditioning, heating, and refrigeration mechanics	2.2	6.6	1.3	3.8	7.3	3.6	3.4	2.0
4710000	Aircraft mechanics and repairmen	2.0	7.6	1.1	4.0	6.9	2.9	2.9	1.7
4720000	Automobile body repairmen	2.9	7.8	1.6	3.1	6.8	2.9	2.9	1.0
4730000	Automobile mechanics	2.2	6.2	1.3	3.9	6.8	3.0	2.8	1.7
4740000	Automobile mechanic apprentices	2.0	6.0	1.0	4.0	7.0	3.0	4.0	3.0
4750000	Data processing machine repairmen	1.8	7.1	1.7	4.3	7.0	2.0	1.8	0.1
4800000	Farm implement mechanics and repairmen	2.1	7.7	1.1	4.0	6.9	3.0	3.4	1.7
4810000	Heavy equipment mechanics, including diesel	2.2	7.5	1.1	3.8	6.8	3.4	3.2	2.1
4820000	Household appliance and accessory installers and mechanics	3.1	6.8	2.3	3.6	5.6	3.0	2.6	0.7
4830000	Loom fixers	2.0	6.0	0.0	4.0	7.0	4.0	3.0	1.8
4840000	Office machine mechanics and repairmen	1.7	7.0	2.0	4.2	6.9	2.1	1.7	0.1

4850000	Radio and television mechanics and repairmen	2.0	7.7	1.2	4.0	6.9	2.6	2.1	0.0
4860000	Railroad and car shop mechanics and repairmen	2.9	7.9	2.0	3.7	6.5	3.6	3.4	1.5
4910000	Mechanic, except auto,apprentices	3.1	7.8	1.8	3.5	6.2	3.8	2.4	1.4
4920000	Miscellaneous mechanics and repairmen	2.5	7.6	1.4	3.5	6.0	2.9	2.6	0.7
4950000	Not specified mechanics and repairmen	2.5	7.4	1.5	3.6	6.4	3.3	3.2	1.7
5010000	Millers; grain, flour, and feed	5.3	7.3	3.8	3.0	5.1	2.8	1.5	1.0
5020000	Millwrights	2.0	8.0	1.0	4.0	7.0	4.0	4.0	2.0
5030000	Molders, metal	3.7	7.3	1.8	3.5	5.8	2.9	2.2	0.9
5040000	Molder apprentices	3.7	7.3	1.8	3.5	5.8	2.9	2.2	0.9
5050000	Motion picture projectionists	3.3	6.2	2.2	3.9	5.7	2.0	2.0	0.0
5060000	Opticians, and lens grinders and polishers	3.0	7.6	1.4	3.7	6.5	2.2	2.0	0.3
5100000	Painters, construction and maintenance	3.2	7.8	1.4	3.2	6.7	2.3	3.8	1.1
5110000	Painter apprentices	3.2	7.8	1.4	3.2	6.7	2.3	3.8	1.1
5120000	Paperhangers	3.0	8.0	1.0	3.9	7.0	2.9	4.0	1.1
5140000	Pattern and model makers, except paper	2.6	8.0	0.5	3.8	6.8	2.8	2.2	0.5
5150000	Photoengravers and lithographers	3.1	7.6	1.9	4.0	7.3	2.4	2.1	0.4
5160000	Piano and organ tuners and repairmen	3.0	6.0	1.0	3.0	5.0	2.0	2.0	0.0
5200000	Plasterers	2.9	6.1	1.3	3.9	7.0	3.8	3.9	1.9
5210000	Plasterer apprentices	2.9	6.1	1.3	3.9	7.0	3.8	3.9	1.9
5220000	Plumbers and pipe fitters	3.0	7.7	1.2	3.9	7.3	3.8	3.8	1.5
5230000	Plumber and pipe fitter apprentices	3.0	8.0	1.0	4.0	7.4	4.0	4.0	1.4
5250000	Power station operators	2.6	6.6	3.7	4.2	7.0	2.3	2.3	1.7
5300000	Pressmen and plate printers, printing	3.7	6.8	2.3	3.7	6.3	2.8	2.0	0.9
5310000	Pressmen apprentices	4.0	6.7	2.7	3.3	5.3	3.0	2.0	2.0
5330000	Rollers and finishers, metal	5.4	7.6	4.3	2.6	3.7	3.0	2.0	2.4
5340000	Roofers and slaters	2.9	8.0	1.1	3.0	7.0	3.0	3.9	2.0
5350000	Sheetmetal workers and tinsmiths	2.2	7.8	1.1	3.9	6.9	3.0	3.8	1.9
5360000	Sheetmetal apprentices	2.0	8.0	1.0	4.0	7.0	3.0	4.0	2.0
5400000	Shipfitters	3.2	8.0	1.4	3.9	7.5	3.8	2.9	1.9

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
5420000	Shoe repairmen	2.8	6.4	1.5	3.1	6.6	2.1	1.8	0.2
5430000	Sign painters and letterers	2.9	8.0	1.0	4.0	7.0	2.0	2.9	0.9
5450000	Stationary engineers	3.1	7.4	2.2	3.7	6.3	2.8	2.8	2.6
5460000	Stonecutters and stone carvers	4.1	7.3	3.5	2.6	4.2	3.4	2.7	1.3
5500000	Structural metal craftsmen	3.3	6.4	1.6	3.2	6.5	3.8	3.6	2.0
5510000	Tailors	3.6	6.9	2.4	3.5	5.9	2.1	2.0	0.5
5520000	Telephone installers and repairmen	2.5	6.8	1.3	3.9	6.1	2.4	3.6	0.2
5540000	Telephone linemen and splicers	2.7	6.4	1.0	4.0	6.9	2.7	3.8	0.8
5600000	Tile setters	3.4	7.7	1.5	3.2	6.4	2.9	3.2	0.3
5610000	Tool and die makers	2.1	7.9	0.3	4.0	6.9	2.9	2.2	0.9
5620000	Tool and die maker apprentices	2.0	8.0	0.0	4.0	7.0	3.0	2.0	1.0
5630000	Upholsterers	4.8	8.0	1.4	3.8	6.7	3.0	2.9	0.5
5710000	Specified craft apprentices, n.e.c.	4.3	7.2	2.9	3.1	4.8	2.7	2.6	1.0
5720000	Not specified apprentices	4.3	7.2	2.9	3.1	4.8	2.7	2.6	1.0
5750000	Craftsmen and kindred workers, n.e.c.	4.3	7.2	2.9	3.1	4.8	2.7	2.6	1.0
6010000	Asbestos and insulation workers	5.3	6.7	3.9	3.1	4.6	3.6	3.4	2.5
6020000	Assemblers	5.4	7.9	4.1	2.5	3.3	2.6	1.9	0.3
6030000	Blasters and powdermen	1.8	6.0	1.0	4.2	7.1	3.3	3.8	2.9
6040000	Bottling and canning operatives	6.0	8.0	5.2	1.9	2.0	2.9	2.0	0.5
6050000	Chainmen, rodmen, and axmen; surveying	5.2	6.3	6.7	2.9	4.0	3.2	3.1	0.2
6100000	Checkers, examiners, and inspectors, manufacturing	4.6	7.6	4.6	3.0	4.1	2.3	2.0	0.4
6110000	Clothing ironers and pressers	6.0	8.0	3.0	2.0	2.2	2.1	1.9	2.8
6120000	Cutting operatives, n.e.c.	5.5	7.8	3.9	2.6	3.6	2.7	2.0	0.8
6130000	Dressmakers and seamstresses, except factory	3.8	6.7	1.6	3.2	5.8	2.0	2.0	0.3

6140000	Drillers, earth	4.8	7.2	3.0	3.0	5.0	3.5	2.2	2.4
6150000	Drywall installers and lathers	5.2	7.1	1.7	3.1	5.8	3.0	4.0	1.6
6200000	Dyers	4.9	7.8	3.8	2.6	3.9	3.1	2.0	1.5
6210000	Filers, polishers, sanders, and buffers	5.4	7.9	4.3	2.2	3.5	2.7	2.0	1.5
6220000	Furnacemen, smeltermen, and pourers	5.0	6.9	3.4	2.5	3.6	3.5	2.0	2.6
6230000	Garage workers and gas station attendants	4.1	6.2	6.6	2.9	3.1	3.0	2.0	0.1
6240000	Graders and sorters, manufacturing	5.5	8.0	6.6	2.0	2.5	2.5	1.9	0.6
6250000	Produce graders and packers, except factory and farm	5.7	7.9	7.0	1.9	2.1	2.7	2.3	0.7
6260000	Heaters, metal	3.0	6.0	1.5	3.5	5.5	2.0	2.0	1.5
6300000	Laundry and dry cleaning operatives, n.e.c.	5.4	7.8	5.5	2.3	2.5	2.6	1.8	1.2
6310000	Meat cutters and butchers, except manufacturing	5.3	7.7	4.3	3.1	5.8	2.8	1.7	1.7
6330000	Meat cutters and butchers, manufacturing	4.9	8.0	3.3	2.4	4.4	3.3	1.9	1.7
6340000	Meat wrappers, retail trade	5.2	8.0	6.4	2.0	2.0	3.1	1.2	0.0
6350000	Metal platers	3.5	7.8	1.4	3.6	5.8	2.9	2.1	1.4
6360000	Milliners	3.8	6.7	1.6	3.2	5.8	2.0	2.0	0.3
	Mine operatives, n.e.c.								
6400480	Coal mining	4.9	7.8	3.6	2.8	4.1	3.8	2.6	2.4
6400490	Crude petroleum and natural gas extractions	4.9	7.7	3.5	2.8	4.8	3.8	2.5	1.6
6400570	Nonmetallic mining and quarrying, except fuel	5.3	7.6	5.2	2.2	2.9	3.9	2.5	2.1
6410000	Mixing operatives	5.4	7.8	4.7	2.4	3.3	3.5	1.7	1.4
6420000	Oilers and greasers, except auto	5.8	7.8	6.7	2.1	3.2	3.0	2.9	1.1
6430000	Packers and wrappers, except meat and produce	5.3	8.0	6.5	2.0	2.2	3.0	1.4	0.3
6440000	Painters, manufactured articles	5.1	7.9	3.8	2.8	4.7	2.8	2.3	1.0
6450000	Photographic process workers	4.2	7.5	2.9	3.1	4.7	1.9	1.8	0.6

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
6500000	Drill press operatives	5.7	7.9	2.1	3.0	3.5	3.1	2.0	1.1
6510000	Grinding machine operatives	4.5	7.9	2.8	2.9	4.5	2.9	2.1	1.3
6520000	Lathe and milling machine operatives	5.1	8.0	3.8	2.5	3.9	3.0	2.0	0.9
6530000	Precision machine operatives, n.e.c.	4.3	7.9	2.7	3.0	5.1	2.9	2.0	0.9
6560000	Punch and stamping press operatives	4.4	7.6	2.5	2.7	4.6	3.7	2.1	1.9
6600000	Riveters and fasteners	5.6	8.0	4.3	2.3	2.9	2.9	2.1	0.9
6610000	Sailors and deckhands	5.1	7.3	6.1	2.5	4.6	3.8	3.5	2.3
6620000	Sawyers	5.3	7.9	3.3	2.7	3.9	3.2	2.3	1.7
6630000	Sewers and stitchers	5.7	7.8	2.3	2.5	3.5	2.0	2.0	0.6
6640000	Shoemaking machine operatives	5.7	7.8	5.1	2.1	2.8	2.1	1.7	0.7
6650000	Solderers	5.5	8.0	4.0	2.6	3.3	2.3	1.9	1.4
6660000	Stationary firemen	4.5	7.2	3.5	3.3	5.0	3.3	3.2	3.0
6700000	Carding, lapping, and combing operatives	5.6	7.8	4.2	2.4	3.4	3.3	2.4	1.9
6710000	Knitters, loopers, and toppers	6.0	6.9	5.1	2.0	3.1	2.7	1.8	0.7
6720000	Spinners, twisters, and winders	5.9	7.8	5.0	2.1	2.9	2.5	2.4	1.1
6730000	Weavers	5.8	7.9	2.4	2.9	4.7	2.1	2.7	1.4
6740000	Textile operatives, n.e.c.	5.4	7.6	4.7	2.3	3.3	2.7	2.1	0.9
6800000	Welders and flame-cutters	3.8	7.8	3.7	3.6	5.1	3.2	3.1	1.8
6810000	Winding operatives, n.e.c.	5.2	7.9	4.0	2.4	4.1	2.5	1.8	0.3
	Machine operatives, miscellaneous specified								
6900990	Construction	5.7	7.3	4.7	2.5	3.5	3.7	2.8	2.0
6901070	Logging	5.2	7.4	4.5	2.6	3.8	3.0	2.0	1.0
6901180	Furniture and fixtures	5.1	8.0	3.9	2.7	3.9	3.0	2.2	1.1
6901190	Glass and glass products	4.2	7.9	3.4	2.6	4.6	3.1	2.6	1.9

6901270	Cement, concrete, gypsum, and plaster products	5.4	6.6	4.6	2.5	3.8	3.2	2.3	1.3
6901280	Structural clay products	4.9	7.5	3.2	2.8	4.5	2.9	2.0	1.3
6901390	Blast furnaces, steel works, rolling and finishing mills	4.8	7.5	3.9	2.5	3.7	3.2	2.0	1.7
6901470	Other primary iron and steel industries	4.8	7.7	3.7	2.6	3.8	3.1	2.3	1.4
6901480	Primary aluminum industries	5.0	7.8	3.8	2.6	3.7	3.2	1.9	1.8
6901570	Cutlery, hand tools, and other hardware	4.3	7.4	3.0	2.9	4.4	2.7	1.9	1.0
6901580	Fabricated structural metal products	5.1	7.7	3.7	2.5	4.4	3.2	2.4	1.9
6901590	Screw machine products	4.8	7.7	3.3	2.8	4.4	3.2	1.9	1.1
6901680	Miscellaneous fabricated metal products	5.3	7.7	4.2	2.4	3.4	2.9	2.1	1.5
6901780	Farm machinery and equipment	4.0	8.0	3.4	3.0	4.8	3.0	2.4	1.0
6901790	Construction and material handling machines	4.6	7.2	2.8	2.6	4.2	3.2	2.2	2.6
6901870	Metalworking machinery	5.4	7.8	4.8	2.4	3.4	2.9	1.9	1.3
6901880	Office and accounting machines	4.9	7.6	3.5	2.9	4.1	2.5	2.2	0.5
6901970	Machinery, except electrical, n.e.c.	4.7	7.6	3.2	2.7	4.2	3.1	2.3	1.4
6901990	Household appliances	6.0	8.0	5.2	2.2	2.8	3.1	1.7	1.4
6902070	Radio, television, and communication equipment	4.6	7.6	3.4	3.3	4.6	2.4	2.0	0.4
6902080	Electrical machinery, equipment, and supplies, n.e.c.	5.0	7.8	4.0	2.5	3.5	2.5	1.9	0.5
6902090	Not specified electrical machinery, equipment, and supplies	6.0	8.0	4.9	2.3	3.0	2.3	2.0	0.7
6902190	Motor vehicles and motor vehicle equipment	4.7	7.7	3.4	2.7	4.1	3.2	2.1	1.3
6902270	Aircraft and parts	4.2	7.4	2.6	3.4	5.4	2.9	2.3	1.3
6902280	Ship and boat building and repairing	5.1	7.5	3.8	3.0	4.6	3.3	2.6	1.1
6902390	Scientific and controlling instruments	4.6	7.9	3.1	2.9	4.3	2.4	1.9	0.7

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
6902570	Not specified professional equipment	5.4	7.6	4.3	2.6	3.4	2.8	1.8	0.8
6902580	Ordnance	5.4	7.5	5.0	2.7	3.7	2.3	1.3	0.7
6902590	Miscellaneous manufacturing industries	5.0	7.6	4.2	2.6	3.8	2.3	1.8	0.7
6902680	Meat products	5.5	7.9	5.4	2.1	2.6	3.1	1.4	1.1
6902690	Dairy products	4.4	7.3	2.7	3.1	5.2	3.4	2.1	2.0
6902780	Canning and preserving fruits, vegetables, and seafoods	5.5	7.9	5.4	2.1	2.6	2.6	1.8	1.3
6902870	Bakery products	5.4	7.9	5.1	2.4	3.0	3.4	1.6	1.1
6902890	Beverage industries	4.7	7.6	5.0	2.4	3.4	3.1	2.0	1.4
6902980	Not specified food industries	5.2	7.4	4.1	2.4	3.8	2.8	2.0	0.7
6902990	Tobacco manufacturers	5.6	8.0	4.9	2.4	3.4	2.7	1.9	1.2
6903190	Apparel and accessories	5.7	8.0	5.3	2.1	2.9	2.3	1.8	0.4
6903270	Miscellaneous fabricated textile products	5.7	8.0	4.4	2.3	3.0	2.1	2.0	0.5
6903280	Pulp, paper, and paperboard mills	4.6	7.1	3.2	2.7	4.4	3.0	2.3	1.7
6903290	Miscellaneous paper and pulp products	5.5	7.8	4.6	2.2	3.5	3.1	2.3	1.2
6903370	Paperboard containers and boxes	5.7	7.7	4.1	2.4	3.2	3.1	2.1	1.2
6903380	Newspaper publishing and printing	4.7	7.4	5.1	2.3	2.9	2.5	1.4	0.6
6903390	Printing, publishing, and allied industries, except newspapers	5.2	7.7	4.0	2.5	4.0	2.4	1.7	0.8
6903470	Industrial chemicals	4.2	7.7	3.2	3.0	5.0	2.7	2.3	1
6903490	Synthetic fibers	5.0	7.5	4.7	2.5	3.5	3.5	2.8	3.0
6903580	Soaps and cosmetics	4.4	7.5	3.2	3.0	4.8	3.2	1.8	2.0
6903690	Not specified chemicals and allied products	4.9	7.7	4.4	2.7	3.9	2.9	2.1	1.2

6903770	Petroleum refining	3.6	7.2	2.4	3.1	5.7	2.5	2.9	2.0
6903790	Rubber products	5.5	7.7	4.2	2.3	3.1	3.0	1.9	0.7
6903870	Miscellaneous plastic products	4.9	7.9	3.7	2.5	3.7	2.8	1.9	0.8
6903880	Tanned, curried, and finished leather	5.7	8.0	5.1	1.9	2.6	2.9	1.4	1.3
6903890	Footwear, except rubber	5.6	7.9	4.7	2.1	3.0	2.3	1.6	0.8
6903970	Leather products, except footwear	5.5	7.2	5.3	2.5	3.7	2.7	1.9	1.0
6904070	Railroads and railway express service	5.4	8.0	3.1	2.5	4.6	3.2	3.1	1.2
6904080	Street railways and bus lines	4.4	6.9	6.0	2.8	4.0	3.4	2.0	1.7
6904990	Communications, and utilities and sanitary services	4.3	7.0	2.9	3.3	5.0	3.3	3.0	1.2
6905990	Wholesale trade	5.4	7.8	4.6	2.5	3.3	3.0	2.1	0.5
6906000	Retail trade	5.3	8.0	4.8	2.4	3.2	3.2	1.9	0.8
6907270	Advertising	5.6	7.9	4.2	2.5	3.7	3.0	1.8	0.9
6909390	Public administration	4.9	7.2	3.7	2.9	4.6	3.2	2.7	0.7
6909990	All other industries	4.3	6.4	5.1	3.5	4.6	2.5	1.9	0.5
6920000	Machine operatives, not specified	5.0	7.6	4.1	2.6	3.8	2.9	2.0	1.1
6940000	Miscellaneous operatives	5.0	7.6	4.1	2.6	3.8	2.9	2.0	1.1
6950000	Not specified operatives	5.0	7.6	4.1	2.6	3.8	2.9	2.0	1.1
7010000	Boatmen and canalmen	6.0	6.0	3.0	3.0	5.0	3.0	2.0	0.0
7030000	Busdrivers	4.0	6.0	3.0	3.0	5.0	3.0	2.0	1.0
7040000	Conductors and motormen, urban rail transit	5.0	6.6	3.7	3.0	4.7	2.8	1.8	1.1
7050000	Deliverymen and routemen	4.2	6.1	3.8	2.9	3.1	2.8	1.7	0.1
7060000	Fork lift and tow motor operatives	5.9	7.8	3.1	2.1	3.1	3.0	2.0	0.2
7100000	Motormen; mine, factory, logging camp, etc.	4.8	6.9	3.3	2.8	4.5	2.3	2.2	1.3
7110000	Parking attendants	4.0	7.0	3.0	2.0	2.0	2.0	1.0	0.0
7120000	Railroad brakemen	3.7	6.0	5.8	2.9	4.0	2.8	3.4	0.9
7130000	Railroad switchmen	4.9	6.2	5.3	2.5	3.3	2.8	1.9	0.7
7140000	Taxicab drivers and chauffeurs	4.4	6.2	3.1	3.0	3.1	2.9	2.0	0.1
7150000	Truck drivers	5.6	7.0	3.1	3.0	3.5	2.6	2.7	0.7
7400000	Animal caretakers, except farm	5.7	6.9	4.8	2.6	3.4	2.9	2.1	0.9

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
7500000	Carpenters' helpers	5.9	6.2	3.9	3.0	4.1	3.9	3.9	2.8
7510000	Construction laborers, except carpenters' helpers	5.8	7.2	5.1	2.6	3.3	4.2	3.3	2.2
7520000	Fishermen and oystermen	5.7	7.7	4.2	2.2	3.5	3.5	3.1	1.6
7530000	Freight and material handlers	5.6	7.7	6.6	2.2	3.0	4.1	2.6	3.2
7540000	Garbage collectors	6.0	7.6	6.2	1.5	1.5	4.4	2.1	1.1
7550000	Gardeners and groundskeepers, except farm	5.4	7.7	5.3	2.3	3.1	3.5	3.0	0.7
7600000	Longshoremen and stevedores	5.5	7.1	5.6	2.5	3.3	4.1	2.0	0.1
7610000	Lumbermen, raftsmen, and woodchoppers	5.4	7.9	4.6	2.2	3.7	4.1	3.5	1.9
7620000	Stockhandlers	5.0	7.6	6.6	2.4	2.6	2.9	1.5	0.1
7630000	Teamsters	6.0	8.0	3.5	2.5	4.0	3.5	3.0	1.5
7640000	Vehicle washers and equipment cleaners	5.7	7.7	6.4	2.1	2.0	3.2	2.3	1.3
7700000	Warehousemen, n.e.c.	5.8	7.9	6.9	2.1	2.3	3.3	1.4	0.9
	Miscellaneous laborers								
7801070	Logging	6.0	8.0	6.1	2.2	2.5	3.8	2.2	2.1
7801180	Furniture and fixtures	5.1	7.3	5.6	2.4	3.5	3.7	2.5	2.4
7801270	Cement, concrete, gypsum, and plaster products	5.7	7.8	5.9	2.1	2.5	4.3	1.8	2.1
7801370	Pottery and related products	6.0	6.0	7.0	1.0	1.0	4.0	1.0	1.0
7801380	Miscellaneous nonmetallic mineral and stone products	6.0	8.0	5.9	2.0	2.8	4.3	2.4	2.7
7801390	Blast furnaces, steel works, rolling and finishing mills	5.9	7.9	6.1	2.0	2.3	3.9	2.8	4.0
7801470	Other primary iron and steel industries	6.0	7.7	6.2	2.1	2.4	3.9	2.4	3.5

7801480	Primary aluminum industries	6.0	7.7	6.5	1.9	2.3	4.0	2.3	2.4
7801690	Not specified metal industries	5.9	7.8	6.5	2.0	2.5	3.8	2.7	3.2
7801770	Engines and turbines	5.7	7.6	5.4	2.3	3.0	3.3	2.8	1.5
7801990	Household appliances	6.0	8.0	7.0	2.0	3.0	3.9	2.6	3.8
7802190	Motor vehicles and motor vehicle equipment	6.0	8.0	5.8	2.0	2.2	3.5	2.0	2.1
7802280	Ship and boat building and repairing	6.0	8.0	7.0	2.0	2.0	4.3	2.3	0.5
7802380	Cycles and miscellaneous transportation equipment	4.9	8.0	4.0	2.8	3.4	3.1	2.4	0.6
7802390	Scientific and controlling instruments	6.0	8.0	7.0	2.0	2.0	3.0	2.0	1.0
7802580	Ordnance	6.0	8.0	7.0	2.0	2.0	3.0	1.0	0.0
7802590	Miscellaneous manufacturing industries	6.0	8.0	6.4	1.6	2.0	3.3	2.0	0.0
7802680	Meat products	5.8	8.0	6.4	1.9	2.1	3.7	2.3	0.8
7802690	Dairy products	6.0	8.0	5.9	2.0	2.4	3.7	2.6	2.9
7802780	Canning and preserving fruits, vegetables, and seafoods	6.0	8.0	6.0	2.0	2.0	3.0	2.0	0.0
7802790	Grain-mill products	6.0	8.0	5.0	2.0	3.0	4.0	1.0	1.0
7802890	Beverage industries	6.0	7.4	5.6	2.3	3.0	4.2	3.3	4.0
7802980	Not specified food industries	6.0	8.0	6.5	1.5	2.5	3.0	2.0	0.3
7802990	Tobacco manufacturers	6.0	8.0	5.0	1.0	2.0	2.0	1.0	0.0
7803170	Yarn, thread, and fabric mills	6.0	8.0	7.0	2.0	2.5	4.0	2.0	2.9
7803180	Miscellaneous textile mill products	6.0	8.0	7.0	2.0	3.0	5.0	3.0	6.0
7803190	Apparel and accessories	6.0	8.0	7.0	2.0	2.5	4.5	3.0	3.1
7803280	Pulp, paper, and paperboard mills	5.7	8.0	5.8	2.0	2.7	3.3	2.4	2.3
7803290	Miscellaneous paper and pulp products	6.0	8.0	6.4	1.9	2.8	4.3	2.5	4.0
7803380	Newspaper publishing and printing	5.0	6.5	7.0	3.0	4.0	3.7	2.2	3.0
7803470	Industrial chemicals	5.9	8.0	6.8	2.0	2.7	4.2	2.3	3.0
7803770	Petroleum refining	6.0	8.0	7.0	2.0	2.7	3.7	3.0	2.2
7803790	Rubber products	5.3	7.7	6.2	2.3	2.9	3.9	2.6	2.0
7803880	Tanned, curried, and finished leather	6.0	8.0	6.1	2.2	2.7	3.6	2.2	1.6

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
7804070	Railroads and railway express service	6.0	7.9	4.4	2.5	3.1	4.4	3.0	1.6
7804080	Street railways and bus lines	5.8	7.6	5.5	2.2	3.0	4.0	2.8	2.3
7804990	Communications, and utilities and sanitary services	5.7	7.7	5.6	2.2	2.8	3.4	2.5	1.4
7805990	Wholesale trade	5.5	7.7	6.3	2.4	2.8	3.3	2.4	1.1
7806000	Retail trade	5.4	7.7	6.3	2.3	2.9	3.6	2.3	1.3
7807270	Advertising	5.6	7.6	5.4	2.5	3.3	3.7	2.8	2.2
7807990	Personal services	5.8	8.0	6.6	2.0	2.3	3.2	3.0	0.1
7809390	Public administration	5.2	8.0	5.6	2.5	3.7	4.1	3.0	1.0
7809990	All other industries	5.4	7.5	4.7	2.6	3.7	3.6	2.9	1.0
7850000	Not specified laborers	5.7	7.7	5.9	2.1	2.8	3.7	2.5	1.9
8010000	Farmers (owners and tenants)	1.5	6.2	1.5	3.8	6.6	3.9	3.7	1.9
8020000	Farm managers	1.4	5.9	4.4	4.2	7.1	2.4	1.7	0.8
8210000	Farm foremen	1.3	5.4	1.8	3.9	6.8	3.6	3.2	1.6
8220000	Farm laborers, wage workers	5.6	7.6	4.6	2.5	3.6	3.7	3.1	1.6
8230000	Farm laborers, unpaid family workers	5.7	7.7	4.5	2.6	3.8	3.9	3.3	1.6
8240000	Farm service laborers, self-employed	6.0	7.4	4.3	2.8	3.7	2.8	2.6	1.4
9010000	Chambermaids and maids, except private household	5.6	7.8	6.7	2.0	2.2	3.0	2.8	0.0
9020000	Cleaners and charwomen	5.4	7.5	6.6	1.7	2.5	3.5	2.8	0.2
9030000	Janitors and sextons	5.0	7.2	4.7	2.5	3.6	3.4	2.8	0.4
9100000	Bartenders	3.9	7.0	4.1	3.0	3.1	2.0	1.9	0.0
9110000	Busboys	5.9	7.0	7.0	2.0	2.0	3.0	2.0	0.0
9120000	Cooks, except private household	3.1	6.3	1.4	3.5	5.9	3.0	1.9	0.9
9130000	Dishwashers	5.9	7.9	6.8	2.1	2.1	3.0	1.1	2.6
9140000	Food counter and fountain workers	4.6	7.0	6.4	2.3	2.5	2.1	1.1	0.2
9150000	Waiters	4.0	6.9	6.9	2.9	3.0	2.0	1.0	0.0

9160000	Food service workers, n.e.c., except private household	5.5	7.6	6.5	2.3	2.6	2.7	1.2	1.8
9210000	Dental assistants	3.0	7.0	1.0	4.0	6.0	2.0	1.0	0.0
9220000	Health aides, except nursing	3.4	6.4	5.9	3.7	4.8	2.2	1.6	0.5
9230000	Health trainees	3.5	7.0	4.0	3.9	5.5	2.8	2.3	0.5
9240000	Lay midwives	4.7	6.9	4.1	3.3	4.4	2.9	2.5	1.2
9250000	Nursing aides, orderlies, and attendants	5.6	6.9	4.3	3.1	3.9	3.1	2.8	1.6
9260000	Practical nurses	3.2	7.0	4.0	3.6	5.2	3.0	2.4	0.7
9310000	Airline stewardesses	3.1	6.1	7.0	3.9	3.0	2.0	2.9	1.9
9320000	Attendants, recreation and amusement	4.6	5.9	6.5	3.0	3.6	2.7	1.8	0.1
9330000	Attendants, personal service, n.e.c.	5.0	6.8	6.6	2.5	3.1	2.7	1.7	0.2
9340000	Baggage porters and bellhops	4.6	6.2	6.3	2.6	3.2	3.5	1.6	0.4
9350000	Barbers	2.9	6.9	1.5	3.1	6.0	2.0	2.0	0.0
9400000	Boardinghouse and lodginghouse keepers	1.3	3.4	6.2	3.8	6.5	2.3	1.3	0.1
9410000	Bootblacks	6.0	7.0	7.0	1.0	2.0	2.0	2.0	0.0
9420000	Child care workers, except private household	5.7	6.8	6.9	3.1	3.2	2.1	1.9	0.1
9430000	Elevator operators	5.5	6.2	3.6	2.2	2.5	2.2	1.0	0.0
9440000	Hairdressers and cosmetologists	2.0	6.8	1.7	3.9	6.0	2.0	2.0	0.0
9450000	Personal service apprentices	2.0	7.0	1.0	4.0	6.0	2.0	2.0	0.0
9500000	Housekeepers, except private household	2.5	5.1	6.5	3.3	5.1	2.3	1.5	0.1
9520000	School monitors	3.6	4.8	6.5	3.7	4.4	2.0	1.0	0.2
9530000	Ushers, recreation and amusement	5.4	7.1	6.1	2.3	2.8	2.2	1.2	0.2
9540000	Welfare service aides	2.2	4.1	6.4	4.4	5.8	1.7	0.8	0.1
9600000	Crossing guards and bridge tenders	4.6	6.2	6.0	2.4	2.6	2.1	1.2	0.3
9610000	Firemen, fire protection	2.8	5.7	4.4	4.0	6.1	4.4	3.5	4.4
9620000	Guards and watchmen	5.4	6.0	6.8	3.0	3.4	2.0	1.2	0.9
9630000	Marshalls and constables	4.0	6.0	5.0	2.5	4.0	2.5	1.0	0.5
9640000	Policemen and detectives	2.1	5.7	4.1	3.9	4.6	2.6	1.7	0.9
9650000	Sheriffs and bailiffs	2.2	6.0	3.2	3.0	4.9	3.0	1.9	1.0
9800000	Child care workers, private household	6.0	7.0	7.0	3.0	3.0	2.0	2.0	0.0

TABLE F-1 (continued)

Occupational Code[b]	Occupational Title	DATA	PEOPLE	THINGS	GED	SVP	STRENGTH	PHYSDEM	ENVIRON
9810000	Cooks, private household	3.2	7.1	3.6	3.0	4.5	2.1	1.4	0.2
9820000	Housekeepers, private household	3.7	6.2	5.4	3.0	3.5	2.3	1.8	0.0
9830000	Laundresses, private household	5.9	8.0	6.2	1.5	2.0	2.1	2.0	0.3
9840000	Maids and servants, private household	4.5	7.2	4.8	2.8	2.8	2.2	2.0	0.0

[a] The DATA, PEOPLE, THINGS, GED, and SVP variables are as described in chapters 2 and 6. The ranges of these variables are 0-6 (DATA), 0-8 (PEOPLE), 0-7 (THINGS), 1-6 (GED), and 1-9 (SVP). The STRENGTH variable was recoded from the alpha characters and ranges from 1 (sedentary) to 5 (very heavy work). The physical demands (PHYSDEM) and environmental conditions (ENVIRON) variables are composite scales ranging from 0 to 4 and from 0 to 6, respectively; PHYSDEM represents the number of physical demands (climbing and/or balancing; stooping, kneeling, crouching, and/or crawling; reaching, handling, fingering, and/or feeling; seeing) required on the job; ENVIRON represents the number of environmental conditions (extreme cold with or without temperature changes; extreme heat with or without temperature changes; wet and/or humid; noise and/or vibration; hazards; atmospheric conditions) existing on the job. For additional information on these occupational characteristics, see the *Handbook for Analyzing Jobs* (U.S. Department of Labor, 1972).

[b] The seven-digit occupation code employed is defined as follows: digits 1-3: 1970 Census occupational classification; digits 4-6: 000, where no industrial distinction; 1970 Census industrial classification otherwise; digit 7: 0 where no class of worker distinction is provided or where the occupation is classified as salaried; 1 where class of worker is self-employed.

TABLE F-2 Factor-Based Scale Scores for 1970 U.S. Census Occupational Categories[a]

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
0010000	Accountants	6.9	2.9	0.0	0.0
0020000	Architects	9.5	6.9	0.1	0.0
0030000	Computer programmers	7.4	4.3	0.3	0.0
0040000	Computer systems analysts	7.6	3.4	0.6	0.0
0050000	Computer specialists, n.e.c.	7.5	3.3	0.5	0.0
0060000	Aeronautical and astronautical engineers	8.7	6.4	1.3	0.0
0100000	Chemical engineers	9.0	6.7	1.2	0.1
0110000	Civil engineers	8.2	7.5	2.3	0.1
0120000	Electrical and electronic engineers	7.7	7.2	1.9	0.1
0130000	Industrial engineers	8.3	4.9	0.7	0.0
0140000	Mechanical engineers	7.5	6.6	1.2	0.2
0150000	Metallurgical and materials engineers	9.1	6.8	0.7	0.0
0200000	Mining engineers	8.3	6.7	4.1	1.6
0210000	Petroleum engineers	9.2	5.1	0.8	0.0
0220000	Sales engineers	6.7	4.2	0.7	0.0
0230000	Engineers, n.e.c.	8.2	6.4	1.0	0.0
0240000	Farm management advisors	6.5	4.8	2.0	0.0
0250000	Foresters and conservationists	5.1	5.2	5.5	0.9
0260000	Home management advisors	7.0	4.7	0.4	0.0
0300000	Judges	9.6	0.0	0.0	0.0
0310000	Lawyers	10.0	2.2	0.0	0.0
0320000	Librarians	5.8	2.7	0.8	0.0
0330000	Archivists and curators	6.7	4.3	2.5	0.0
0340000	Actuaries	7.7	2.9	0.0	0.0
0350000	Mathematicians	9.5	3.2	0.2	0.0
0360000	Statisticians	8.3	2.7	0.1	0.0

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
0420000	Agricultural scientists	6.7	5.9	3.8	0.0
0430000	Atmospheric and space scientists	6.8	4.3	0.0	0.0
0440000	Biological scientists	8.6	7.6	0.9	0.0
0450000	Chemists	9.2	7.5	0.1	0.1
0510000	Geologists	9.6	6.6	5.4	2.2
0520000	Marine scientists	9.6	6.4	2.3	0.0
0530000	Physicists and astronomers	9.4	7.5	0.2	0.0
0540000	Life and physical scientists, n.e.c.	8.0	3.2	0.0	0.0
0550000	Operations and systems researchers and analysts	7.0	3.5	0.5	0.0
0560000	Personnel and labor relations workers	6.8	2.5	0.1	0.0
0610000	Chiropractors	6.6	9.4	1.0	0.0
0620000	Dentists	8.8	7.9	1.0	0.0
0630000	Optometrists	7.2	7.8	0.0	0.0
0640000	Pharmacists	7.6	7.8	0.0	0.0
0650000	Physicians, medical and osteopathic	8.9	9.9	0.8	0.0
0710000	Podiatrists	6.5	6.0	0.1	0.0
0720000	Veterinarians	8.0	9.7	1.0	0.0
0730000	Health practitioners, n.e.c.	6.6	9.4	1.0	0.0
0740000	Dietitians	6.4	4.0	0.0	0.0
0750000	Registered nurses	6.1	6.6	1.0	0.0
0760000	Therapists	6.3	6.6	1.0	0.0
0800000	Clinical laboratory technologists and technicians	5.8	8.4	0.4	0.0
0810000	Dental hygienists	5.9	9.5	0.1	0.0
0820000	Health record technologists and technicians	5.4	2.3	0.5	0.0
0830000	Radiologic technologists and technicians	5.3	7.2	2.9	0.0
0840000	Therapy assistants	5.5	7.3	1.0	0.0

0850000	Health technologists and technicians, n.e.c.	5.1	5.5	0.7	0.1
0860000	Clergymen	9.3	2.2	0.0	0.0
0900000	Religious workers, n.e.c.	7.5	2.6	0.3	0.0
0910000	Economists	7.1	3.1	0.1	0.0
0920000	Political scientists	6.2	3.5	0.4	0.0
0930000	Psychologists	8.5	3.9	0.0	0.1
0940000	Sociologists	8.5	2.2	0.0	0.0
0950000	Urban and regional planners	8.1	4.3	0.3	0.0
0960000	Social scientists, n.e.c.	8.4	2.6	0.4	0.0
1000000	Social workers	6.7	2.3	0.1	0.0
1010000	Recreation workers	6.8	3.2	1.4	0.0
1020000	Agriculture teachers	8.5	2.2	0.0	0.0
1030000	Atmospheric, earth, marine, and space teachers	8.9	3.8	2.0	0.0
1040000	Biology teachers	8.4	2.4	0.0	0.0
1050000	Chemistry teachers	8.5	2.8	0.0	0.0
1100000	Physics teachers	8.3	2.5	0.0	0.0
1110000	Engineering teachers	8.4	2.7	0.1	0.0
1120000	Mathematics teachers	8.4	2.2	0.0	0.0
1130000	Health specialties teachers	8.0	2.7	0.2	0.0
1140000	Psychology teachers	8.5	2.2	0.0	0.0
1150000	Business and commerce teachers	8.5	2.2	0.0	0.0
1160000	Economics teachers	8.4	2.4	0.0	0.0
1200000	History teachers	8.2	2.2	0.0	0.0
1210000	Sociology teachers	8.5	2.2	0.0	0.0
1220000	Social science teachers, n.e.c.	8.5	2.2	0.0	0.0
1230000	Art, drama, and music teachers	8.2	4.9	0.2	0.0
1240000	Coaches and physical education teachers	7.5	4.6	3.6	0.0
1250000	Education teachers	8.4	2.2	0.0	0.0
1260000	English teachers	7.8	2.6	0.0	0.0
1300000	Foreign language teachers	7.8	2.2	0.0	0.0
1310000	Home economics teachers	7.9	4.2	0.4	0.0
1320000	Law teachers	8.5	2.2	0.0	0.0

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
1330000	Theology teachers	8.5	2.2	0.0	0.0
1340000	Trade, industrial, and technical teachers	7.0	5.0	1.6	0.0
1350000	Miscellaneous teachers, college and university	8.4	2.3	0.0	0.0
1400000	Teachers, college and university, subject not specified	7.8	2.9	0.2	0.0
1410000	Adult education teachers	6.6	3.4	0.6	0.0
1420000	Elementary school teachers	6.2	3.6	1.0	0.0
1430000	Prekindergarten and kindergarten teachers	5.0	4.4	2.4	0.0
1440000	Secondary school teachers	6.4	3.0	0.6	0.0
1450000	Teachers, except college and university, n.e.c.	7.2	6.3	1.2	0.0
1500000	Agriculture and biological technicians	4.9	6.5	0.8	0.1
1510000	Chemical technicians	5.5	7.1	1.0	0.1
1520000	Draftsmen	6.5	8.3	0.1	0.0
1530000	Electrical and electronic engineering technicians	6.2	8.3	0.8	0.0
1540000	Industrial engineering technicians	5.2	5.1	0.0	0.0
1550000	Mechanical engineering technicians	5.7	7.7	0.4	0.0
1560000	Mathematical technicians	7.2	5.5	0.0	0.0
1610000	Surveyors	6.4	6.6	5.7	0.0
1620000	Engineering and science technicians, n.e.c.	5.6	7.0	0.8	0.2
1630000	Airplane pilots	6.7	7.3	4.2	0.0
1640000	Air traffic controllers	6.0	5.8	0.0	0.0
1650000	Embalmers	6.0	5.3	2.0	0.0
1700000	Flight engineers	6.6	7.1	2.7	0.0
1710000	Radio operators	4.4	4.8	0.3	0.0
1720000	Tool programers, numerical control	6.2	3.7	0.2	0.0
1730000	Technicians, n.e.c.	5.1	6.2	1.1	0.0
1740000	Vocational and educational counselors	7.5	3.0	0.1	0.0

1750000	Actors	6.2	3.5	2.7	0.0
1800000	Athletes and kindred workers	5.4	7.2	6.9	0.1
1810000	Authors	8.6	2.6	0.1	0.0
1820000	Dancers	6.9	5.9	7.8	0.0
1830000	Designers	7.4	7.7	0.4	0.0
1840000	Editors and reporters	7.7	3.7	0.2	0.0
1850000	Musicians and composers	8.0	7.9	2.5	0.0
1900000	Painters and sculptors	7.2	10.0	0.3	0.0
1910000	Photographers	6.4	7.4	1.2	0.1
1920000	Public relations men and publicity writers	8.3	3.7	0.0	0.0
1930000	Radio and television announcers	6.4	2.6	0.2	0.0
1940000	Writers, artists, and entertainers, n.e.c.	6.3	4.3	1.3	0.2
1950000	Research workers, not specified	7.0	4.5	0.8	0.0
2010000	Assessors, controllers, and treasurers; local public administration	7.1	2.9	1.9	0.0
2020000	Bank officers and financial managers	7.5	2.6	0.1	0.0
2030000	Buyers and shippers, farm products	6.5	3.2	0.3	0.0
2050000	Buyers, wholesale and retail trade	6.3	3.6	0.1	0.0
2100000	Credit men	7.1	2.3	0.0	0.0
2110000	Funeral directors	6.0	3.8	1.2	0.0
2120000	Health administrators	7.0	3.4	0.2	0.2
2130000	Construction inspectors, public administration	6.7	3.9	6.7	0.0
	Inspectors, except construction, public administration				
2159170	Federal administration and postal service	5.0	5.0	1.5	0.7
2159270	State public administration	4.9	4.2	2.1	0.0
2159370	Local public administration	5.6	3.8	3.0	0.0
2160000	Managers and superintendents, building	5.4	3.8	1.3	0.0
2200000	Office managers, n.e.c.	6.3	2.4	0.1	0.0
2210000	Officers, pilots, and pursers; ship	5.6	6.4	5.2	1.0
	Officials and administrators, public administration, n.e.c.				
2229170	Federal administration and postal service	6.8	2.6	0.2	0.0
2229270	State public administration	6.1	3.3	2.5	0.0

TABLE F-2 (continued)

Occupational Code [b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
2229370	Local public administration	6.0	3.3	1.1	0.3
2230000	Officials of lodges, societies, and unions	6.8	2.5	0.5	0.0
2240000	Postmasters and mail superintendents	5.9	2.2	0.0	0.0
2250000	Purchasing agents and buyers, n.e.c.	6.3	2.9	0.1	0.0
2260000	Railroad conductors	5.2	4.2	4.5	0.0
2300000	Restaurant, cafeteria, and bar managers	5.7	3.6	0.0	0.1
2310000	Sales managers and department heads, retail trade	6.2	2.7	0.1	0.0
2330000	Sales managers, except retail trade	7.1	2.3	0.1	0.0
2350000	School administrators, college	7.2	2.5	0.0	0.0
2400000	School administrators, elementary and secondary	7.2	2.5	0.3	0.0
	Managers and administrators, n.e.c.				
2450990	Construction, salaried	6.5	4.1	2.3	0.0
2450991	Construction, self-employed	5.3	6.2	4.0	0.1
2452990	Tobacco manufactures, salaried	6.9	2.9	0.3	0.0
2452991	Tobacco manufactures, self-employed	6.1	3.7	0.7	0.0
2453990	Manufacturing, nondurable goods, salaried	7.0	2.7	0.1	0.0
2453991	Manufacturing, nondurable goods, self-employed	5.6	4.0	0.7	0.4
2454390	Transportation, salaried	6.2	2.6	0.3	0.0
2454391	Transportation, self-employed	4.8	3.8	2.1	0.0
2454990	Communications, and utilities and sanitary services, salaried	6.8	3.1	0.6	0.0
2454991	Communications, and utilities and sanitary services, self-employed	3.5	4.3	1.8	0.0
2455990	Wholesale trade, salaried	6.8	2.5	0.2	0.0
2455991	Wholesale trade, self-employed	6.4	2.8	0.6	0.0

	Retail trade				
2456070	Lumber and building material, salaried	6.1	2.6	0.1	0.0
2456071	Lumber and building material, self-employed	6.1	2.7	0.1	0.0
2456090	Department and mail order establishments, salaried	6.0	2.5	0.2	0.0
2456091	Department and mail order establishments, self-employed	6.3	2.3	0.1	0.0
2456280	Grocery stores, salaried	6.1	2.4	0.1	0.0
2456281	Grocery stores, self-employed	5.7	2.7	0.2	0.1
2456390	Motor vehicle dealers, salaried	6.1	3.1	0.4	0.0
2456391	Motor vehicle dealers, self-employed	6.0	2.7	0.8	0.1
2456480	Gasoline service stations, salaried	4.9	2.9	1.1	0.0
2456481	Gasoline service stations, self-employed	4.9	2.8	1.2	0.0
2456570	Apparel and accessories stores (except shoes), salaried	6.2	2.6	0.1	0.0
2456571	Apparel and accessories stores (except shoes), self-employed	5.8	3.1	0.1	0.0
2456670	Furniture and home furnishings stores, salaried	6.4	2.3	0.0	0.0
2456671	Furniture and home furnishing stores, self-employed	5.9	3.1	0.2	0.0
2456990	Other retail trade, salaried	6.1	2.5	0.0	0.0
2456991	Other retail trade, self-employed	6.0	2.8	0.1	0.2
2457190	Finance, insurance, and real estate, salaried	6.7	2.6	0.2	0.0
2457191	Finance, insurance, and real estate, self-employed	6.3	3.3	0.8	0.0
2457270	Advertising, salaried	6.4	3.2	0.6	0.1
2457271	Advertising, self-employed	5.7	4.2	1.0	0.2
2457990	Personal services, salaried	5.7	2.7	1.0	0.2
2457991	Personal services, self-employed	5.4	2.7	0.9	0.4
2459980	All other industries, salaried	6.8	3.0	0.5	0.0
2459981	All other industries, self-employed	5.8	3.3	1.5	0.1
2600000	Advertising agents and salesmen	5.8	2.8	0.0	0.0
2610000	Auctioneers	4.4	3.9	0.0	0.0

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
2620000	Demonstrators	3.9	5.2	0.6	0.0
2640000	Hucksters and peddlers	3.7	3.8	0.8	0.1
2650000	Insurance agents, brokers, and underwriters	6.4	3.4	0.0	0.0
2660000	Newsboys	0.7	2.3	4.5	0.0
2700000	Real estate agents and brokers	5.3	3.3	0.0	0.0
2710000	Stock and bond salesmen	7.0	2.6	0.0	0.0
2800000	Salesmen and sales clerks, n.e.c.	3.9	4.2	0.3	0.0
2810000	Sales representatives, manufacturing industries	4.6	3.1	0.1	0.0
2820000	Sales representatives, wholesale trade	4.6	3.0	0.2	0.0
2830000	Sales clerks, retail trade	3.4	4.7	0.2	0.0
2840000	Salesmen, retail trade	4.3	4.2	1.3	0.0
2850000	Salesmen of services and construction	4.4	3.4	0.4	0.0
3010000	Bank tellers	5.6	8.2	0.0	0.0
3030000	Billing clerks	2.6	6.0	0.1	0.0
3050000	Bookkeepers	4.4	6.1	0.0	0.0
3100000	Cashiers	3.2	7.3	0.0	0.0
3110000	Clerical assistants, social welfare	3.5	4.9	0.1	0.0
3120000	Clerical supervisors, n.e.c.	5.9	3.1	0.1	0.0
3130000	Collectors, bill and account	4.1	2.3	1.1	0.0
3140000	Counter clerks, except food	2.5	3.7	0.2	0.3
3150000	Dispatchers and starters, vehicle	4.1	3.1	0.0	0.0
3200000	Enumerators and interviewers	3.4	4.2	0.9	0.0
3210000	Estimators and investigators, n.e.c.	5.0	3.4	0.3	0.0
3230000	Expediters and production controllers	4.2	4.1	0.3	0.2
3250000	File clerks	2.9	4.6	1.0	0.0
3260000	Insurance adjusters, examiners, and investigators	6.0	2.3	0.9	0.0

3300000	Library attendants and assistants	3.5	4.2	2.1	0.0
3310000	Mail carriers, post office	3.2	5.3	1.4	0.0
3320000	Mail handlers, except post office	2.8	3.7	0.2	0.0
3330000	Messengers and office boys	1.2	2.9	2.5	0.0
3340000	Meter readers, utilities	3.5	1.0	4.5	0.0
3410000	Bookkeeping and billing machine operators	4.1	6.5	0.2	0.0
3420000	Calculating machine operators	3.0	5.7	0.0	0.0
3430000	Computer and peripheral equipment operators	3.9	6.0	0.8	0.0
3440000	Duplicating machine operators	1.7	5.0	0.2	0.0
3450000	Key punch operators	2.5	6.2	0.1	0.0
3500000	Tabulating machine operators	2.6	5.4	0.3	0.0
3550000	Office machine operators, n.e.c.	3.0	5.7	0.5	0.3
3600000	Payroll and timekeeping clerks	3.9	6.8	0.0	0.0
3610000	Postal clerks	3.1	4.8	0.1	0.0
3620000	Proofreaders	4.1	3.7	0.0	0.0
3630000	Real estate appraisers	6.9	2.2	4.9	0.0
3640000	Receptionists	3.8	2.8	0.0	0.0
3700000	Secretaries, legal	5.5	8.3	0.0	0.0
3710000	Secretaries, medical	5.6	8.2	0.0	0.0
3720000	Secretaries, n.e.c.	5.5	8.3	0.0	0.0
3740000	Shipping and receiving clerks	3.0	3.9	0.1	0.1
3750000	Statistical clerks	3.6	5.0	0.2	0.0
3760000	Stenographers	3.1	7.1	0.0	0.0
3810000	Stock clerks and storekeepers	2.9	3.7	1.3	0.1
3820000	Teacher aides, except school monitors	4.5	2.9	0.1	0.0
3830000	Telegraph messengers	1.2	2.9	2.5	0.0
3840000	Telegraph operators	3.6	6.8	0.0	0.0
3850000	Telephone operators	2.9	5.7	0.0	0.0
3900000	Ticket, station, and express agents	4.4	3.6	0.5	0.0
3910000	Typists	2.6	6.7	0.0	0.0
3920000	Weighers	1.7	4.3	0.6	0.4

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
	Miscellaneous clerical workers				
3943980	Manufacturing industries	3.1	5.3	0.1	0.0
3944980	Transportation, communications, and other public utilities	3.4	4.5	0.1	0.0
3945980	Wholesale trade	2.8	4.8	0.1	0.0
3947190	Finance, insurance, and real estate	3.6	4.9	0.1	0.0
3948980	Professional and related services	3.5	4.9	0.1	0.0
3949390	Public administration	3.3	5.0	0.2	0.0
3949980	Other miscellaneous clerical workers	3.0	5.0	0.2	0.1
3950000	Not specified clerical workers	3.2	4.9	0.1	0.0
4010000	Automobile accessories installers	4.4	5.0	1.3	0.0
4020000	Bakers	4.0	6.5	0.3	0.9
4030000	Blacksmiths	3.7	7.8	3.1	2.3
4040000	Boilermakers	4.9	6.3	6.1	0.0
4050000	Bookbinders	3.1	7.6	0.8	0.0
4100000	Brickmasons and stonemasons	4.4	6.6	7.8	0.7
4110000	Brickmasons and stonemasons, apprentices	4.6	7.1	8.9	0.0
4120000	Bulldozer operators	2.3	5.8	7.3	0.0
4130000	Cabinetmakers	4.4	6.9	1.7	0.0
4150000	Carpenters	4.7	7.0	8.4	0.1
4160000	Carpenter apprentices	4.7	7.0	8.7	0.0
4200000	Carpet installers	3.4	7.4	1.7	0.0
4210000	Cement and concrete finishers	3.1	5.9	7.8	2.0
4220000	Compositors and typesetters	4.5	7.1	0.3	0.0
4230000	Printing trades apprentices, except pressmen	4.6	8.2	0.7	0.0
4240000	Cranemen, derrickmen, and hoistmen	2.2	5.5	3.3	0.1

4250000	Decorators and window dressers	6.0	8.7	0.7	3.0
4260000	Dental laboratory technicians	5.0	8.0	0.7	0.0
4300000	Electricians	5.9	7.0	7.2	0.0
4310000	Electrician apprentices	6.1	7.2	7.9	0.0
4330000	Electric power linemen and cablemen	4.6	7.3	7.2	0.2
4340000	Electrotypers and stereotypers	4.6	7.5	0.7	0.6
4350000	Engravers, except photoengravers	4.1	7.3	1.4	0.0
4360000	Excavating, grading, and road machine operators; except bulldozer	3.2	5.9	5.9	0.1
4400000	Floor layers, except tile setters	2.8	6.7	5.3	0.0
	Foremen, n.e.c.				
4410990	Construction	5.7	4.8	4.1	0.0
4411390	Blast furnaces, steel works, rolling and finishing mills	5.8	5.3	1.2	0.4
4411770	Engines and turbines	5.8	5.0	0.7	0.1
4411990	Household appliances	5.5	4.8	0.5	0.0
4412190	Motor vehicles and motor vehicle equipment	5.9	4.9	1.3	0.1
4412590	Other durable goods	5.8	5.1	0.2	0.1
4412680	Meat products	5.3	4.6	1.1	0.6
4413070	Knitting mills	4.9	4.9	0.5	0.0
4413980	Other nondurable goods	5.6	4.9	1.0	0.1
4414390	Transportation	5.3	3.9	2.0	0.1
4414990	Communications, and utilities and sanitary services	5.9	4.7	2.2	0.2
4415980	Wholesale trade	5.5	3.7	1.0	0.0
4419980	All other industries	5.5	4.5	1.9	0.2
4420000	Forgemen and hammermen	2.8	6.2	3.0	3.0
4430000	Furniture and wood finishers	2.9	6.2	1.7	0.0
4440000	Furriers	6.3	8.6	1.0	0.0
4450000	Glaziers	3.4	6.0	6.3	0.0
4460000	Heat treaters, annealers, and temperers	2.9	5.8	2.1	2.8
4500000	Inspectors, scalers, and graders; log and lumber	2.8	5.3	2.0	0.0
	Inspectors, n.e.c.				

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
4520990	Construction	5.8	3.9	7.8	0.0
4524070	Railroads and railway express service	2.8	4.0	4.3	0.0
4529990	All other industries	4.0	4.6	3.0	0.5
4530000	Jewelers and watchmakers	5.1	7.3	0.0	0.1
4540000	Job and die setters, metal	4.4	6.8	2.2	0.1
4550000	Locomotive engineers	3.6	6.2	1.2	0.1
4560000	Locomotive firemen	3.4	6.2	1.1	0.0
4610000	Machinists	4.9	8.3	2.0	0.0
4620000	Machinist apprentices	4.7	7.8	2.6	0.3
4700000	Air conditioning, heating, and refrigeration mechanics	4.9	6.5	5.4	1.3
4710000	Aircraft mechanics and repairmen	5.1	7.1	5.2	0.1
4720000	Automobile body repairmen	4.4	6.7	1.7	0.0
4730000	Automobile mechanics	4.4	7.5	2.6	0.0
4740000	Automobile mechanic apprentices	4.5	7.9	6.7	0.0
4750000	Data processing machine repairmen	5.6	7.3	0.2	0.0
4800000	Farm implement mechanics and repairmen	4.9	7.6	5.6	0.2
4810000	Heavy equipment mechanics, including diesel	4.8	7.3	4.8	0.8
4820000	Household appliance and accessory installers and mechanics	3.9	6.1	2.8	0.3
4830000	Loom fixers	4.0	7.3	1.7	0.0
4840000	Office machine mechanics and repairmen	5.6	6.6	0.1	0.0
4850000	Radio and television mechanics and repairmen	4.6	7.8	0.7	0.0
4860000	Railroad and car shop mechanics and repairmen	4.4	6.0	5.8	0.6
4910000	Mechanic, except auto, apprentices	4.1	6.3	5.1	0.2
4920000	Miscellaneous mechanics and repairmen	4.4	6.9	2.7	0.1
4950000	Not specified mechanics and repairmen	4.5	7.1	4.6	0.7
5010000	Millers; grain, flour, and feed	2.4	4.6	0.0	0.0

5020000	Millwrights	5.5	7.2	7.6	0.1
5030000	Molders, metal	3.3	6.1	1.1	0.3
5040000	Molder apprentices	3.3	6.1	1.1	0.3
5050000	Motion picture projectionists	4.3	7.4	0.0	0.0
5060000	Opticians, and lens grinders and polishers	4.5	7.2	0.4	0.0
5100000	Painters, construction and maintenance	4.3	8.2	7.4	0.0
5110000	Painter apprentices	4.3	8.2	7.4	0.0
5120000	Paperhangers	4.8	8.4	7.0	0.0
5140000	Pattern and model makers, except paper	4.7	7.1	0.5	0.3
5150000	Photoengravers and lithographers	4.7	7.2	0.4	0.0
5160000	Piano and organ tuners and repairmen	3.4	5.5	1.7	0.0
5200000	Plasterers	4.3	7.0	8.6	2.1
5210000	Plasterer apprentices	4.3	7.0	8.6	2.1
5220000	Plumbers and pipe fitters	4.8	7.1	7.5	0.0
5230000	Plumber and pipe fitter apprentices	4.9	7.3	7.9	0.0
5250000	Power station operators	5.2	5.3	2.9	1.3
5300000	Pressmen and plate printers, printing	3.8	7.0	0.5	0.2
5310000	Pressmen apprentices	3.0	6.8	0.7	1.8
5330000	Rollers and finishers, metal	1.9	5.0	1.9	1.7
5340000	Roofers and slaters	3.1	6.5	10.0	0.0
5350000	Sheetmetal workers and tinsmiths	4.9	7.0	7.1	0.0
5360000	Sheetmetal apprentices	5.0	7.1	7.9	0.0
5400000	Shipfitters	4.8	6.7	9.4	0.0
5420000	Shoe repairmen	3.8	7.2	1.7	0.0
5430000	Sign painters and letterers	5.6	9.7	6.2	0.0
5450000	Stationary engineers	4.2	5.7	4.0	2.4
5460000	Stonecutters and stone carvers	1.6	5.1	5.1	0.0
5500000	Structural metal craftsmen	3.8	6.3	8.4	0.2
5510000	Tailors	3.7	7.4	0.8	0.0
5520000	Telephone installers and repairmen	4.5	7.4	5.8	0.0
5540000	Telephone linemen and splicers	4.8	7.3	7.1	0.2
5600000	Tile setters	3.7	6.8	3.1	0.1

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
5610000	Tool and die makers	5.0	7.8	0.5	0.0
5620000	Tool and die maker apprentices	5.0	8.1	0.0	0.0
5630000	Upholsterers	3.6	7.6	1.6	0.0
5710000	Specified craft apprentices, n.e.c.	2.9	6.1	3.6	0.3
5720000	Not specified apprentices	2.9	6.1	3.6	0.3
5750000	Craftsmen and kindred workers, n.e.c.	2.9	6.1	3.6	0.3
6010000	Asbestos and insulation workers	1.9	5.7	7.4	0.0
6020000	Assemblers	1.8	5.6	0.8	0.0
6030000	Blasters and powdermen	5.0	7.1	7.6	0.0
6040000	Bottling and canning operatives	1.0	5.8	1.4	0.5
6050000	Chainmen, rodmen, and axmen; surveying	1.9	4.0	5.8	0.0
6100000	Checkers, examiners, and inspectors, manufacturing	2.6	5.8	0.5	0.1
6110000	Clothing ironers and pressers	0.5	5.0	3.4	4.7
6120000	Cutting operatives, n.e.c.	1.9	5.3	1.3	0.1
6130000	Dressmakers and seamstresses, except factory	3.4	7.6	1.0	0.0
6140000	Drillers, earth	2.7	5.4	5.3	0.6
6150000	Drywall installers and lathers	2.8	6.5	6.9	0.0
6200000	Dyers	1.9	4.9	0.8	2.4
6210000	Filers, polishers, sanders, and buffers	1.8	5.2	1.0	0.4
6220000	Furnacemen, smeltermen, and pourers	1.6	5.4	2.6	2.7
6230000	Garage workers and gas station attendants	2.3	3.2	2.8	0.1
6240000	Graders and sorters, manufacturing	1.1	4.7	0.9	0.8
6250000	Produce graders and packers, except factory and farm	1.0	5.4	0.9	1.7
6260000	Heaters, metal	3.6	6.6	2.0	1.5
6300000	Laundry and dry cleaning operatives, n.e.c.	1.2	3.9	1.3	2.1
6310000	Meat cutters and butchers, except manufacturing	2.1	6.6	1.6	3.8

6330000	Meat cutters and butchers, manufacturing	2.0	6.2	1.8	3.6
6340000	Meat wrappers, retail trade	1.1	5.4	0.1	0.2
6350000	Metal platers	3.4	6.2	0.3	1.4
6360000	Milliners	3.4	7.6	1.0	0.0
	Mine operatives, n.e.c.				
6400480	Coal mining	2.3	5.2	4.3	0.2
6400490	Crude petroleum and natural gas extractions	2.8	5.4	6.3	0.1
6400570	Nonmetallic mining and quarrying, except fuel	1.2	4.2	4.5	0.3
6410000	Mixing operatives	1.9	4.4	1.4	0.4
6420000	Oilers and greasers, except auto	0.8	4.7	2.1	0.2
6430000	Packers and wrappers, except meat and produce	1.2	5.1	0.7	0.5
6440000	Painters, manufactured articles	2.6	6.7	2.2	0.0
6450000	Photographic process workers	3.2	6.8	0.5	0.8
6500000	Drill press operatives	1.9	6.1	0.5	0.0
6510000	Grinding machine operatives	2.6	5.8	0.8	0.1
6520000	Lathe and milling machine operatives	2.1	6.0	0.3	0.1
6530000	Precision machine operatives, n.e.c.	2.9	5.8	0.6	0.0
6560000	Punch and stamping press operatives	2.9	5.4	3.1	0.2
6600000	Riveters and fasteners	1.8	5.1	2.0	0.0
6610000	Sailors and deckhands	1.6	5.3	8.9	2.0
6620000	Sawyers	2.2	5.1	3.7	0.3
6630000	Sewers and stitchers	1.7	7.2	1.4	0.0
6640000	Shoemaking machine operatives	1.2	5.0	0.8	0.0
6650000	Solderers	1.9	5.9	1.3	0.0
6660000	Stationary firemen	2.8	5.7	5.4	3.4
6700000	Carding, lapping, and combing operatives	1.5	5.8	1.2	1.1
6710000	Knitters, loopers, and toppers	1.2	5.8	0.4	0.0
6720000	Spinners, twisters, and winders	1.2	5.8	1.5	0.1
6730000	Weavers	2.5	6.7	1.4	0.0
6740000	Textile operatives, n.e.c.	1.7	5.5	1.0	0.5
6800000	Welders and flame-cutters	3.4	6.6	4.8	1.2
6810000	Winding operatives, n.e.c.	2.3	5.6	0.2	0.0

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
	Machine operatives, miscellaneous specified				
6900990	Construction	1.5	4.7	5.4	0.0
6901070	Logging	2.1	4.6	2.8	0.1
6901180	Furniture and fixtures	2.2	5.4	1.9	0.7
6901190	Glass and glass products	2.3	5.5	4.0	1.5
6901270	Cement, concrete, gypsum, and plaster products	1.6	4.6	3.4	0.3
6901280	Structural clay products	2.5	5.8	2.2	0.8
6901390	Blast furnaces, steel works, rolling and finishing mills	2.2	4.9	2.6	0.5
6901470	Other primary iron and steel industries	2.1	5.2	1.9	0.8
6901480	Primary aluminum industries	2.0	5.1	1.7	1.4
6901570	Cutlery, hand tools, and other hardware	2.6	5.6	0.8	0.4
6901580	Fabricated structural metal products	2.1	5.1	3.5	1.0
6901590	Screw machine products	2.6	5.4	1.5	0.2
6901680	Miscellaneous fabricated metal products	1.7	5.0	2.1	0.9
6901780	Farm machinery and equipment	3.0	6.1	2.3	0.0
6901790	Construction and material handling machines	2.3	5.4	2.6	0.6
6901870	Metalworking machinery	1.6	5.5	1.4	0.3
6901880	Office and accounting machines	2.3	6.8	1.1	0.0
6901970	Machinery, except electrical, n.e.c.	2.5	5.7	2.3	0.2
6901990	Household appliances	1.3	4.6	1.8	1.2
6902070	Radio, television, and communication equipment	2.9	6.3	1.2	0.4
6902080	Electrical machinery, equipment, and supplies, n.e.c.	2.0	5.4	1.1	0.0
6902090	Not specified electrical machinery, equipment, and supplies	1.9	5.9	1.0	0.0
6902190	Motor vehicles and motor vehicle equipment	2.3	5.4	2.2	0.7
6902270	Aircraft and parts	3.5	5.9	2.4	0.4

6902280	Ship and boat building and repairing	2.6	5.4	3.1	0.0
6902390	Scientific and controlling instruments	2.9	5.6	0.9	0.2
6902570	Not specified professional equipment	1.4	5.7	0.4	0.5
6902580	Ordnance	2.0	4.6	0.9	0.0
6902590	Miscellaneous manufacturing industries	2.1	5.4	1.1	0.4
6902680	Meat products	1.2	4.2	1.3	1.9
6902690	Dairy products	3.2	5.5	2.1	3.7
6902780	Canning and preserving fruits, vegetables, and seafoods	1.5	5.0	1.4	1.5
6902870	Bakery products	2.0	4.7	1.7	1.3
6902890	Beverage industries	2.2	4.7	1.7	2.5
6902980	Not specified food industries	2.1	4.8	1.3	0.5
6902990	Tobacco manufacturers	1.8	4.9	1.4	0.3
6903190	Apparel and accessories	1.2	5.0	0.9	0.5
6903270	Miscellaneous fabricated textile products	1.2	5.9	1.3	0.8
6903280	Pulp, paper, and paperboard mills	2.5	5.3	2.2	1.2
6903290	Miscellaneous paper and pulp products	1.4	4.8	1.6	0.8
6903370	Paperboard containers and boxes	1.4	4.8	1.8	0.8
6903380	Newspaper publishing and printing	1.7	4.8	1.2	0.4
6903390	Printing, publishing, and allied industries, except newspapers	2.1	5.7	0.8	0.3
6903470	Industrial chemicals	2.8	5.4	1.8	0.0
6903490	Synthetic fibers	1.7	4.4	3.7	3.9
6903580	Soaps and cosmetics	2.4	5.0	1.2	1.4
6903690	Not specified chemicals and allied products	2.0	5.2	1.7	0.2
6903770	Petroleum refining	3.7	5.4	4.9	0.0
6903790	Rubber products	1.5	5.2	1.2	0.3
6903870	Miscellaneous plastic products	2.0	5.6	0.9	0.4
6903880	Tanned, curried, and finished leather	0.3	3.9	1.4	1.0
6903890	Footwear, except rubber	1.6	4.7	1.2	0.7
6903970	Leather products, except footwear	1.9	4.9	1.6	1.4
6904070	Railroads and railway express service	2.3	5.6	4.0	0.6
6904080	Street railways and bus lines	2.5	4.5	4.4	1.0

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
6904990	Communications, and utilities and sanitary services	3.2	5.6	4.7	0.5
6905990	Wholesale trade	1.4	5.1	2.2	0.1
6906000	Retail trade	1.7	4.9	1.2	1.0
6907270	Advertising	1.3	4.3	1.3	0.4
6909390	Public administration	2.7	5.1	2.6	0.5
6909990	All other industries	3.4	4.6	1.4	0.4
6920000	Machine operatives, not specified	2.0	5.2	1.8	0.6
6940000	Miscellaneous operatives	2.0	5.2	1.8	0.6
6950000	Not specified operatives	2.0	5.2	1.8	0.6
7010000	Boatmen and canalmen	1.3	6.1	2.1	0.0
7030000	Busdrivers	2.3	6.1	2.1	0.0
7040000	Conductors and motormen, urban rail transit	2.4	5.3	1.8	0.0
7050000	Deliverymen and routemen	2.3	4.5	3.1	0.0
7060000	Fork lift and tow motor operatives	1.2	5.4	3.4	0.1
7100000	Motormen; mine, factory, logging camp, etc.	2.4	5.9	3.8	0.0
7110000	Parking attendants	1.4	3.6	3.3	0.0
7120000	Railroad brakemen	2.2	5.2	7.0	0.0
7130000	Railroad switchmen	1.2	5.0	4.2	0.0
7140000	Taxicab drivers and chauffeurs	2.1	6.0	2.4	0.0
7150000	Truck drivers	2.2	5.9	4.7	0.0
7400000	Animal caretakers, except farm	1.4	5.8	2.9	0.1
7500000	Carpenters' helpers	1.3	5.9	8.7	0.2
7510000	Construction laborers, except carpenters' helpers	1.3	4.6	8.3	0.3
7520000	Fishermen and oystermen	1.7	4.5	7.6	2.3
7530000	Freight and material handlers	1.4	3.5	5.5	4.7
7540000	Garbage collectors	0.3	3.6	4.6	0.2

7550000	Gardeners and groundskeepers, except farm	1.2	3.7	7.1	0.0
7600000	Longshoremen and stevedores	1.4	4.0	4.5	0.0
7610000	Lumbermen, raftsmen, and woodchoppers	1.7	5.0	8.2	0.8
7620000	Stockhandlers	1.7	3.9	1.4	0.2
7630000	Teamsters	1.8	5.7	7.1	0.0
7640000	Vehicle washers and equipment cleaners	1.1	3.6	3.2	2.0
7700000	Warehousemen, n.e.c.	1.1	3.6	2.2	1.5
	Miscellaneous laborers				
7801070	Logging	1.2	3.9	5.4	1.5
7801180	Furniture and fixtures	1.8	4.0	4.7	3.4
7801270	Cement, concrete, gypsum, and plaster products	1.3	3.4	3.6	2.2
7801370	Pottery and related products	0.3	3.0	1.2	0.0
7801380	Miscellaneous nonmetallic mineral and stone products	1.0	4.2	3.5	3.9
7801390	Blast furnaces, steel works, rolling and finishing mills	1.0	3.5	6.0	4.3
7801470	Other primary iron and steel industries	0.9	3.7	4.6	3.6
7801480	Primary aluminum industries	0.8	3.4	4.3	2.7
7801690	Not specified metal industries	1.0	3.8	5.3	3.8
7801770	Engines and turbines	1.4	4.5	4.8	1.0
7801990	Household appliances	1.1	4.0	5.1	6.4
7802190	Motor vehicles and motor vehicle equipment	1.1	4.2	2.3	1.4
7802280	Ship and boat building and repairing	0.5	2.4	5.4	0.0
7802380	Cycles and miscellaneous transportation equipment	2.5	5.0	3.0	0.4
7802390	Scientific and controlling instruments	0.9	3.0	1.7	2.4
7802580	Ordnance	0.9	3.0	0.0	0.0
7802590	Miscellaneous manufacturing industries	0.6	3.8	2.0	0.0
7802680	Meat products	0.9	3.9	2.8	1.0
7802690	Dairy products	1.2	3.7	4.4	4.5
7802780	Canning and preserving fruits, vegetables, and seafoods	0.9	3.1	1.7	0.0
7802790	Grain-mill products	2.1	4.1	0.0	2.4
7802890	Beverage industries	0.9	4.1	7.2	5.1
7802980	Not specified food industries	0.8	3.6	1.6	0.7
7802990	Tobacco manufacturers	0.0	3.3	0.0	0.0

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
7803170	Yarn, thread, and fabric mills	1.0	3.3	4.4	4.9
7803180	Miscellaneous textile mill products	1.1	2.9	7.9	10.0
7803190	Apparel and accessories	0.8	3.4	5.4	5.2
7803280	Pulp, paper, and paperboard mills	1.4	3.1	5.4	3.1
7803290	Miscellaneous paper and pulp products	1.1	3.4	5.6	6.6
7803380	Newspaper publishing and printing	2.7	2.7	5.4	5.0
7803470	Industrial chemicals	1.1	3.7	3.7	4.5
7803770	Petroleum refining	0.8	3.0	7.6	0.0
7803790	Rubber products	1.3	4.1	4.3	3.0
7803880	Tanned, curried, and finished leather	0.7	4.6	3.0	2.5
7804070	Railroads and railway express service	1.5	4.4	6.7	0.5
7804080	Street railways and bus lines	1.4	4.0	5.6	2.7
7804990	Communications, and utilities and sanitary services	1.0	3.8	6.0	0.9
7805990	Wholesale trade	1.5	4.2	3.2	1.3
7806000	Retail trade	1.4	3.8	3.8	2.2
7807270	Advertising	1.5	4.3	5.2	2.8
7807990	Personal services	0.2	3.3	5.9	0.1
7809390	Public administration	1.6	4.0	5.0	1.7
7809990	All other industries	1.8	4.6	5.5	1.1
7850000	Not specified laborers	1.3	3.9	4.8	2.2
8010000	Farmers (owners and tenants)	5.2	5.1	7.4	0.1
8020000	Farm managers	5.9	4.0	3.6	0.1
8210000	Farm foremen	5.1	5.5	6.2	0.0
8220000	Farm laborers, wage workers	1.3	5.0	6.7	0.3
8230000	Farm laborers, unpaid family workers	1.1	5.1	7.4	0.0
8240000	Farm service laborers, self-employed	1.4	6.2	3.4	0.0

9010000	Chambermaids and maids, except private household	0.9	3.2	4.3	0.0
9020000	Cleaners and charwomen	0.7	3.5	4.1	0.2
9030000	Janitors and sextons	2.1	4.8	4.5	0.1
9100000	Bartenders	1.9	5.0	0.1	0.0
9110000	Busboys	0.9	2.3	2.6	0.0
9120000	Cooks, except private household	3.9	5.5	0.6	1.6
9130000	Dishwashers	0.6	3.0	2.7	4.6
9140000	Food counter and fountain workers	1.5	3.9	0.4	0.3
9150000	Waiters	2.1	3.3	1.1	0.0
9160000	Food service workers, n.e.c., except private household	1.1	3.7	1.9	2.9
9210000	Dental assistants	4.6	5.4	0.0	0.0
9220000	Health aides, except nursing	4.2	5.0	0.8	0.5
9230000	Health trainees	4.0	5.8	2.1	0.0
9240000	Lay midwives	2.2	5.6	3.0	0.1
9250000	Nursing aides, orderlies, and attendants	1.1	5.6	4.1	0.0
9260000	Practical nurses	3.5	6.1	1.8	0.0
9310000	Airline stewardesses	3.8	3.7	7.4	0.0
9320000	Attendants, recreation and amusement	2.7	4.1	2.7	0.1
9330000	Attendants, personal service, n.e.c.	1.7	3.4	1.7	0.3
9340000	Baggage porters and bellhops	1.8	3.6	2.1	0.0
9350000	Barbers	4.6	7.7	0.0	0.0
9400000	Boardinghouse and lodginghouse keepers	5.2	3.3	1.1	0.0
9410000	Bootblacks	0.0	3.6	1.7	0.0
9420000	Child care workers, except private household	1.0	3.0	1.7	0.0
9430000	Elevator operators	1.7	4.1	0.1	0.0
9440000	Hairdressers and cosmetologists	5.1	9.2	0.0	0.0
9450000	Personal service apprentices	5.2	8.6	0.0	0.0
9500000	Housekeepers, except private household	3.7	3.5	1.4	0.1
9520000	School monitors	3.3	3.7	1.6	0.2
9530000	Ushers, recreation and amusement	1.6	4.2	1.7	0.0
9540000	Welfare service aides	5.2	3.1	0.9	0.0
9600000	Crossing guards and bridge tenders	1.6	3.1	3.1	0.3

TABLE F-2 (continued)

Occupational Code[b]	Occupational Title	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
9610000	Firemen, fire protection	4.2	6.7	8.7	4.6
9620000	Guards and watchmen	2.8	3.5	2.9	0.0
9630000	Marshalls and constables	2.3	3.8	2.6	0.0
9640000	Policemen and detectives	4.1	5.3	4.4	0.0
9650000	Sheriffs and bailiffs	3.5	5.3	5.1	0.0
9800000	Child care workers, private household	0.4	3.0	1.7	0.0
9810000	Cooks, private household	2.4	4.0	1.2	0.3
9820000	Housekeepers, private household	1.7	3.6	1.9	0.0
9830000	Laundresses, private household	0.6	3.7	2.3	0.4
9840000	Maids and servants, private household	0.7	4.0	2.5	0.0

[a] Scales converted to a 0-10 range (the lowest-scoring occupation is coded zero, and the highest-scoring occupation is coded 10). See text for additional information on derivation of scales.

[b] The seven-digit occupation code is defined as follows: digits 1-3: 1970 Census occupational classification; digits 4-6: 000, where no industrial distinction; 1970 Census industrial classification otherwise; digit 7: 0 where no class of worker distinction is provided or where the occupation is classified as salaried; 1 where class of worker is self-employed.

TABLE F-3 Decision Rules for Assigning DOT Scores to Missing Occupational Categories

Occupation Code	Census Occupational Title	Decision Rule
073	Health practitioners, n.e.c.	Same as Chiropractors
084	Therapy assistants	Weighted average of Clinical laboratory technologists and technicians; Dental hygienists; Health record technologists and technicians; Radiologic technologists and technicians; and Health technologists and technicians, n.e.c.
280	Salesmen and sales clerks, n.e.c.	Weighted average of Sales representatives, manufacturing industries; Sales representatives, wholesale trade; Sales clerks, retail trade; Salesmen, retail trade; Salesmen of services and construction
311	Clerical assistance, social welfare	Same as Miscellaneous clerical workers, Professional and related services
383	Telegraph messengers	Same as Messengers and office boys
395	Not specified clerical workers	Weighted average of subcategories of Miscellaneous clerical workers (3943980-3949980)
504	Molder apprentices	Same as Molders, metal
511	Painter apprentices	Same as Painters, construction and maintenance
521	Plasterer apprentices	Same as Plasterers
571	Specified craft apprentices, n.e.c.	Same as Craftsmen and kindred workers, n.e.c.
572	Not specified apprentices	Same as Craftsmen and kindred workers, n.e.c.
580	Former members of the Armed Forces	No score assigned
636	Milliners	Same as Dressmakers and seamstresses, except factory
692	Machine operatives, not specified	Weighted average of subcategories of Machine operatives, miscellaneous specified (6900990-6909990)
694	Miscellaneous operatives	Same as 692
695	Not specified operatives	Same as 692

TABLE F-3 (continued)

Occupation Code	Census Occupational Title	Decision Rule
785	Not specified laborers	Weighted average of subcategories of Miscellaneous laborers (7801070-7809990)
924	Lay midwives	Weighted average of Dental assistants; Health aides, except nursing; Health trainees; Nursing aides, orderlies, and attendants; and Practical nurses

TABLE F-4 Factor Loadings: Varimax Rotated Factor Matrix[a]

	Factor			
Variable	Substantive Complexity	Motor Skills	Physical Demands	Undesirable Working Conditions
DATA	**0.92**	0.01	−0.14	−0.17
THINGS	0.05	**0.89**	0.12	−0.06
GED	**0.95**	−0.03	−0.17	−0.13
SVP	**0.93**	0.14	−0.02	−0.12
INTELL	**0.92**	−0.10	−0.18	−0.15
VERBAL	**0.90**	−0.18	−0.25	−0.14
NUMER	**0.84**	−0.01	−0.17	−0.12
MOTOR	−0.06	**0.82**	0.08	−0.09
FINGDEX	0.08	**0.84**	−0.08	−0.08
MANDEX	−0.31	**0.78**	0.21	−0.01
EYEHAND	−0.07	0.20	**0.64**	0.01
COLORDIS	0.15	**0.52**	0.00	0.17
ABSTRACT	**0.83**	0.13	−0.04	−0.10
REPCON	**−0.81**	−0.10	−0.01	0.24
CLIMB	−0.03	0.06	**0.89**	0.20
STOOP	−0.29	0.07	**0.69**	0.15
SEE	0.04	**0.71**	0.13	−0.09
LOCATION	−0.11	−0.07	**0.73**	−0.02
COLD	−0.16	−0.08	0.12	**0.66**
HEAT	−0.20	−0.01	0.11	**0.71**
WET	−0.28	−0.05	0.14	**0.66**
HAZARDS	−0.14	0.21	**0.68**	0.33

[a] See text for description of variables. Scores on DATA, THINGS, INTELL, VERBAL, NUMER, MOTOR, FINGDEX, MANDEX, EYEHAND, and COLORDIS were reflected so that high scores represent high levels of the trait. Coefficients in boldface indicate that the item is included in the scale.

APPENDIX

G

Using Computers to Match Workers and Jobs: A Preliminary Assessment of the U.S. Employment Service's Automated Matching System

CHARLES F. TURNER

The task of matching workers and employment opportunities requires extensive record-keeping. Files of job openings must be continually updated; jobs that have been filled must be removed from the files and new listings must be added. A similar process occurs for files containing descriptions of available workers. To be kept current, these files must also be regularly updated.

Most important, there must be regular searches of the files to find suitable openings for each worker and suitable workers for each opening. The matching of workers with available jobs is, after all, the reason for the existence of a government-funded employment service. One ideal for such service is the following:

1. Each time a worker comes to the Employment Service, a search will be made for an appropriate opening currently on file with the Employment Service.
2. On a daily basis each worker on file at the Employment Service will

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Since this work was requested late in the lifetime of the committee and since it required detailed familiarization with the operation of a complicated computer system, this undertaking was assigned to a member of the committee's staff. While the following analyses have been discussed by the committee, the responsibility for this review resides with the staff member who undertook this work and authored this appendix.

be compared with all available employment openings to determine if any available jobs are suitable for him or her.

To appreciate the magnitude of the record-keeping and file-searching involved in the operation of the Employment Service, let us consider the situation in one city we visited. During the month of January 1978 the local Employment Service office in Houston, Texas, listed 2,829 job openings and 3,884 workers registered with the office.

In a fully comprehensive, unstructured search of the file of job openings, one would have to make nearly 11 million individual comparisons to determine whether there were any appropriate openings for each of the 3,884 workers registered with the Houston Employment Service. The enormous magnitude of this task dictates that comprehensive and unstructured file searches should be avoided. Clearly, a more efficient strategy of searching for appropriate matches of workers and jobs is required.

For this reason the Employment Service has traditionally restricted the scope of the file searches that are routinely performed. Workers are never compared, one by one, against the entire file of available jobs. Instead, each worker and each job order are assigned to a narrow occupational category. This traditionally has been done by selecting one of the approximately 12,000 base titles from the DOT to describe each worker and each job. Ordinarily workers are matched against only the file of available job openings in the particular occupation in which they were coded.[1] The use of this DOT-based search strategy dramatically reduces the amount of file-searching required to match workers and jobs.

The efficiency of the DOT matching strategy can be seen in our example. If the 3,884 workers and 2,839 job openings in Houston were uniformly spread across 300 occupations (an improbable event, we admit), the number of individual comparisons between job orders and worker descriptions required for a complete file search would be reduced from approximately 11 million to 37,000. If the workers and job openings were spread over a larger number of occupational titles, the number of comparisons required decreases, assuming a uniform distribution of workers and jobs across occupations. To the extent that the distributions become uneven (i.e., some occupations having more workers or jobs than others), the number of comparisons will increase. At one extreme one has the case of one worker and one job per occupational title; in this case the number of comparisons required to perform a DOT search is exactly equal to the total number of workers in the files. At the other extreme, if all workers and jobs are in the same occupation, a DOT-based search strategy is the same as an unrestricted search (i.e., nearly 11 million individual comparisons would be required in the example).

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[1] To accommodate workers who have experience or qualifications for more than one occupation, duplicate occupational assignments are sometimes made.

The DOT file searches are considerably less burdensome than unrestricted or unsystematic searches. File-searching is reduced by simply limiting the number of jobs for which workers will be considered and, likewise, by restricting the number of workers who will be considered for each job opening. Such a strategy in many cases seems appropriate. There is little reason to compare individually a group of records describing workers with experience in the performing arts to job orders for scientists. However, it is not clear that this strategy is always in the best interests of workers and employers. In particular, we note that this strategy assumes that there is no transferability of skills between occupations. Moreover, for occupations that do not have formal entry qualifications (educational requirements or occupational licenses), such a search strategy unnecessarily restricts the opportunities of workers to find employment.

There are, of course, hybrid search strategies that preserve the efficiency inherent in the use of a single classification structure to categorize workers and jobs but avoid locking in workers to the specific occupations in which they have previously worked. Those methods are briefly described in a later section of this appendix.

First we will consider how the Employment Service has automated the operation of its local offices. In considering this program we note that our interviews with the staff of the Department of Labor and local Employment Service offices and the studies conducted by others (e.g., U.S. General Accounting Office, 1978) indicate that DOT applicant and job order files are not frequently searched for matches of applicants with new job orders. Only one third of all referrals resulted from manual file searches done subsequent to an applicant's initial appearance in the Employment Service office. Data such as these were used to support the original proposal for the automation of the Employment Service's placement activities.

AUTOMATION AND JOB-WORKER MATCHING IN THE EMPLOYMENT SERVICE

An initial distinction must be made between the automation of the Employment Service's operations and the particular type of computerized method it uses for matching workers and jobs. The latter system, called keywording, is not the only way of matching workers and job orders by computer. Matching could, for example, be performed using the traditional DOT-based search strategy; the file-searching and record-keeping would be done by the computer rather than manually. Indeed, the present keyword matching system includes an option that permits the automated matching of workers and jobs using DOT codes. The computer searches for an exact match between the DOT code(s) assigned to a particular worker and those on job orders in the job bank.

The automation of the clerical and record-keeping tasks involved in job placement has many obvious benefits. Those benefits, however, accrue to automation, not to the keyword system. In this appendix we do not comment on the effects of automation per se; rather we assess the implications of automation for the Employment Service's occupational analysis program and, indirectly, for the quality of the job-worker matching done by the U.S. Employment Service.

DEVELOPMENT OF SYSTEMS

In the early 1960s the Employment and Training Administration (then the Manpower Administration) began to support studies of automated job-worker matching. Initially, funding was provided to the states of California, New York, Utah, and Wisconsin. Automated matching systems based on aspects of the *Dictionary of Occupational Titles* were developed in New York and Utah.

The experimental system developed by New York matched jobs and workers using DOT codes. Members of the committee and staff viewed the operations of this system during a visit to the occupational analysis field center in New York. The system in its present form serves the City of New York; not only does it make file searches by direct matching of DOT codes, but it also incorporates a hybrid procedure that allows workers with one DOT code to be matched to job orders with different DOT codes that are thought to be sufficiently similar to permit suitable referrals. For example, in the New York matching system the computer first searches its files using an automated version of the manual DOT search strategy; if this search is unsuccessful, it may be augmented by the use of a cross-reference list of similar occupations stored in the computer. For each DOT code the computer refers to this list to determine what DOT codes will provide suitable matches for a particular applicant (or job order). So, for example, when a Batter Mixer (520.685-014) comes to the New York City office seeking appropriate employment, she or he might be considered not only for openings as a Batter Mixer but also for those as Blender Machine Operator (520.685-018), Cake Stripper (520.685-042), Candy Puller (520.685-046), Confectionery Drops Machine Operator (520.685-078), etc.

The initial judgments about what are similar occupations were made by staff of the Employment Service, and they can be continuously revised.

While we cannot evaluate the overall adequacy or comprehensiveness of the judgments of similarity incorporated in the New York system, the New York matching system illustrates how flexibility might be built into a hybrid system based on an explicit and detailed occupational classification such as the *Dictionary of Occupational Titles*.

Work by the Employment Service in other states took different paths. Some attempted to define occupational similarity, and others attempted to develop descriptive vocabularies. A brief catalogue of these attempts is useful in appreciating the history of the current keyword system.

In Wisconsin an experimental system was developed using the worker trait arrangement (GED, SVP, physical demands, etc.) of the DOT to define the similarity of occupations, and thereby to specify the sorts of job-worker matches that might be made. In contrast, an experimental system originally developed by the State of California does not rely on the *Dictionary of Occupational Titles*. The California system, known as the Labor Inventory Network Communication System (LINCS), is similar in many fundamental ways to the keyword system (described below). A distinguishing characteristic of the LINCS system is its attempt to provide a language for describing occupations that includes natural language elements; this system does not rely on an explicit, predetermined classification of all occupations.

The early development of these automated systems for the centralization of information about job openings and available workers reflected the recommendations made by various advisory bodies. For example, the National Commission on Technology and the American Economy recommended in 1966 that the government establish such computerized placement systems to assist workers dislocated by automation.

During the late 1960s and early 1970s, further experimental systems for job-worker matching were developed. One system, Job Analysis Vocabulary (JAV), was developed using the language of job analysis to describe the characteristics of particular jobs and the experience of individual workers. This system explicitly rejected the concept of "occupation" as the bridge for matching workers and jobs. Instead, it attempted to describe the characteristics of particular jobs, without fitting them into a preconceived set of occupational categories. The developers of this system envisioned that Employment Service interviewers would do very abbreviated job analyses of each opening in their files. The presence of common task-related terms (e.g., driving van, collecting money, delivering products, etc.) in the job description and the history of an applicant would produce matches.

The great advantage of such descriptive systems is flexibility. Once we allow the idiosyncrasies of each job to be faithfully mirrored in a matching system, it becomes possible to tailor job specifications to the needs of a particular employer. Moreover, the system ensures that all of the idiosyncrasies of a given job will be used during the process of job-worker matching. In such a system, workers and jobs can be described and matched even if they contain elements of two or, theoretically, hundreds of occupations. For example, a school that needs a guidance counselor who can also teach Greek can have a job order written to specify that experience in both of these occupations is a prerequisite for employment.

A second-generation LINCS system was subsequently produced; it is known as the Detailed Computer Assisted Language (DECAL). While the original LINCS system was restricted to a range of technical and professional occupations, DECAL covers the entire occupational spectrum.

After a series of field studies of the performance of state Employment Service offices using the various systems, the Division of Automated Matching of the Employment Service concluded that the second-generation automated systems (JAV and DECAL) have a demonstrated superiority to manual methods of job-worker matching. The Employment Service subsequently committed itself to an automation program estimated to cost $250 million (U.S. General Accounting Office, 1978).

KEYWORDING: THE EMPLOYMENT SERVICE MATCHING SYSTEM

The matching system resulting from this experimental work was released in 1975 by the Division of Automated Matching of the Employment Service. At present, 23 states have received funding for automation, and the Department of Labor anticipates automating Employment Services across the nation by 1984.

Our interest in automated matching focuses on its characteristics as a tool for facilitating the employment and mobility of labor. A survey by the Bureau of Labor Statistics (U.S. General Accounting Office, 1977:6) indicated that one third of all job seekers use the U.S. Employment Service. A system that increases the opportunities of these workers to find desired jobs would make a significant contribution to the country's well-being.

The present keyword system used by the Employment Service incorporates many features that are a natural concomitant of automation. For example, the system permits automated elimination from matching of jobs that do not satisfy workers' criteria for hours of work, geographic location, salary, etc. Thus workers who specify that they will not work night shifts are never matched against jobs requiring night work. Similarily, workers who are not willing to travel from their homes to jobs in distant locations are not considered for such openings. These aspects of keywording are an obvious use of computer capabilities to assist in the matching of workers and jobs. As noted earlier, since such features are not unique to keywording, we will not consider them at length. However, we do note one inefficiency of the present keyword system. It arises because Employment Service counselors must code keywords describing applicants with a numerical code. Thus despite the fact that the keyword system uses ordinary English words to describe applicants and jobs, it is necessary for the interviewers to consult a code book to translate these words into a five-digit numerical code. This task is one that could be easily performed by a computer. It is inefficient to require human interviewers to recode the standardized keyword vocabulary into numeric digits. We suspect that this requirement decreases interviewers' efficiency and increases the occurrence of errors in the coding of workers and jobs.

DESCRIPTION

The keyword system is based on a vocabulary that segments all occupations into 36 occupational areas (occupational units). The organization of the occupational units reflects the early concentration of the LINCS system on technical and professional occupations. Thus there are nine separate units describing professional occupations. Indeed, there are separate units for writing, artwork, and the performing arts, even though the Employment Service receives relatively few job openings in these three areas. As Table G-1 shows, approximately .4 of all workers are concentrated in 4 of the 36 keyword occupational units: clerical, service, general labor, and business administration.

The major reference document for the keyword system is the *Handbook of Occupational Keywords* (U.S. Department of Labor, 1972). The *Handbook* contains a complete listing of the descriptive vocabulary used by the keyword system. The description of the 36 occupational units has much in common with traditional classifications of occupations. Indeed, its descriptions of the occupational units contain an explicit list of the occupations for which each unit is appropriate.

This aspect of the keyword system is of particular interest, since the developers of the keyword system claim that it is not an occupational

TABLE G-1 Estimate of the Distribution of the National Labor Force by Keyword Occupational Units

Occupational Units	Percentage of the Labor Force
Scientific/technical	
(1) biological sciences	0.2
(2) health sciences	4.9
(3) physical sciences	0.8
(4) social sciences	1.1
(5) engineering/drafting	3.5
Education and the arts	
(6) education/library	6.3
(7) writing/translating	0.3
(8) artwork	0.8
(9) performing arts	0.2
Marketing and sales	
(10) insurance/real estate	1.8
(11) sales	2.1
Business	
(12) business administration	5.2
(13) electronic data processing	0.6
(14) clerical	14.2
(15) inspecting/quality control/appraising	1.7
Construction, structural and extraction	
(16) construction/metal structural work	5.9
(17) welding	1.1
(18) installation/maintenance/repair	6.5
(19) construction/shop painting	0.9
(20) mining/drilling	0.4
Manufacturing: machine work	
(21) machining/machine operating	5.6
(22) woodworking	0.2
(23) cloth/leather working	2.6
Manufacturing: fabricating	
(24) printing/paperwork	0.8
(25) technical/electrical equipment fabricating	0.1
(26) metal products fabricating	0.4
(27) mixed materials fabricating	0.0
(28) rubber/plastics fabricating	0.0
Manufacturing: processing	
(29) stone/clay/glass/sand working	0.4
(30) processing	0.4
(31) textile preparation/finishing	0.5
Services	
(32) services	6.1
(33) transportation	5.5
(34) utilities/communications	0.7

Continued overleaf

TABLE G-1 (continued)

Occupational Units	Percentage of the Labor Force
General labor and general services	
(35) agriculture/fishing/logging	4.6
(36) general labor/general services	13.7

SOURCE: This tabulation was derived by assigning each of the 441 detailed census categories from the 1970 Census classification of occupations to keyword major groups and then retabulating the occupational distribution for a 4-percent sample of the 1970 Census. Assignment of keyword occupational units to the detailed census codes was done for us by staff of the U.S. Employment Service's Division of Automated Matching Systems. Because we have been forced to use the census occupations as a link in estimating this distribution, this tabulation represents only a rough approximation of the true distribution. There is, however, no feasible way to generate more reliable estimates at the present time.

classification. The fact that the *Handbook* lists almost 600 occupational titles in its description of the occupational units suggests otherwise.[2] Furthermore, the primary keywords listed in the *Handbook* appear in general to be occupational titles that have been grammatically transformed, e.g., sociology work (sociologist), anthropology work (anthropologist), tool making–die making (tool and die maker), motor generator assembling (motor-generator assembler), drama directing (drama director). Indeed, where this is not the case one finds special notes identifying the relevant occupational title, e.g., the occupational keyword: "Death Investigating" Work (56310) contains a special note advising the reader: "identifies work of coroner."

For each of the 36 occupational units the keyword system provides a special vocabulary of terms to describe work in the unit. These terms consist of two types: primary and complementary. The primary terms are meant to describe the major work activities. For example, the unit Biological Science contains primary terms for botany, microbiology, zoology, etc. The complementary keyword terms cover such things as materials, products, equipment, or tools associated with particular areas of work. In addition, for units covering professional occupations, complementary terms may also describe subject areas and languages involved in the work. For example, the Biological Sciences unit contains complementary terms describing educational areas, such as "Environmental Science." By coding this keyword one can specify particular educational characteristics of a job or worker. Similarily, occupational keywords for this unit describe research specialties as well as the various types of plants and animals that might be studied by someone doing agricultural research. Finally, there is a set of complementary terms describing the various locations in which work might be performed, e.g., a medical laboratory, a botanical garden, etc. Complementary keywords are specific to an occupational unit and its associated primary terms; thus selection of a primary term, e.g., biological work, constrains the domain of complementary terms that will be used to describe the work.

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[2] It should be noted that the 1970 Census classification of occupations contains many fewer occupational titles than those listed in the *Handbook of Occupational Keywords*.

To use the keyword system to code a job or worker, an Employment Service interviewer must do the following:

1. The appropriate occupational unit or units that characterize the worker (note that primary terms from more than one occupational unit may be used to describe workers or jobs) must be determined.
2. All primary terms needed to describe the major work activities must be selected.
3. All appropriate complementary terms to define the other characteristics of the work or worker must be selected.
4. He or she must code the information concerning the geographic location of the job and worker's residence, salary levels offered by the employer and acceptable to workers, and certain other specific matching information, e.g., whether the job requires an occupational license and whether the worker holds such a license; shifts worked; job duration; work week; etc.
5. Finally, for job orders, the keywords must be formatted into simple sentences to describe the exact nature of the employer's requirements. The vocabularly permits two types of specification for job qualifications. A characteristic may be "required" or "desired." When the former is specified, workers lacking this characteristic are excluded from consideration. When more than one worker meets all required criteria, the system will select those workers having more of the desired characteristics. A job order may specify the characteristics of jobs in terms of (required or desired) education, experience, knowledge, or skill.

Descriptions of jobs are constructed by first specifying the major field of work and then listing all of the desired and/or required skills, experience, education, or knowledge specified by the employer. For example, one might have a job order coded as follows: (1) primary term: Botany, (2) complementary terms: master's degree in Botany required, 3 years' experience in microbiology required, skill in research desired, and knowledge of statistical methodology desired, and (3) non-occupational terms: work week, 40 hours; job duration, 150+ days; shift, first shift (normal day); working conditions, inside; public transportation, not available; geographical location, special map code; and salary, $20,000/year. Workers, in turn, are described in terms of their work experience and education. Experience is quantified in terms of the number of months worked, and education is coded into six descriptive categories: special courses, vocational-technical school training, associate's, bachelor's, master's, or doctoral degree.

Matching is performed by searching for instances in which the requirements of a given job are satisfied by a worker's education and experience. In the matching strategy used by the keyword system, the primary terms, which describe major work areas such as biological work, have a logical precedence in matching over the complementary terms. Skill and knowledge requirements in job orders may be satisfied by either the worker's formal education or his or her work experience. The information coded about salary levels, geographic locations, etc. is used to eliminate job-worker matches on non-occupational criteria.[3] If many applicants fulfill all of the job requirements, i.e., have coded on their file all of the keywords that were required on the job order, they are rank-ordered by the number of desired keywords that the applicant and job order have in common. The applicant with the most keywords in common with the job order is the first-ranked candidate for referral.

EVALUATING KEYWORD MATCHING

Many aspects of the keyword matching system can be evaluated conceptually. Evaluation of the impact of keywording on the actual functioning of the Employment Service, however, requires data that were not available to us—data that, in fact, have not been collected.

Although the evaluation studies (U.S. Department of Labor, 1976a) conducted by the Employment Service's Division of Automated Matching concluded that keyword matching was demonstrably superior in terms of efficiency, cost, and quality of placements to manual search methods or alternative automated systems, two important inadequacies in the design of these studies make these conclusions questionable.

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[3] We have ignored in this discussion the use of non-occupational criteria in matching; the principles are the same but a number of the criteria involve simple exclusion rules (e.g., exclude night work jobs if applicants want day work) or simple *ad hoc* formulae (e.g., exclude jobs that offer less than 80 percent of an applicant's salary requirement).

First, the studies did not distinguish between the effect of automation per se and the effect of particular matching systems.[4] Since automation could be accomplished in a variety of ways other than keywording, one cannot confidently attribute the observed differences between manual procedures and automation to keywording. It could instead be argued that all of the effects were due to factors such as the automation of record-keeping, changes in the routing of applicants through Employment Service offices, changes in management procedures induced by automation, and so forth. One theoretically could even argue that keywording may have diminished the otherwise salutary effects of automation. The evidence provided by the studies is simply inconclusive on this point.

Second, the studies made no estimates of the effects of temporal fluctuations in the economy on the operations of the Employment Service. Neither experimental controls nor any adjustment procedures were used to allow for effects of changes in the national economy or the local labor markets on the probability of a worker's finding employment.

In our assessment the available evidence (i.e., U.S. Department of Labor, 1976a) is insufficient to support the conclusion that keywording improved efficiency. A recent study by the General Accounting Office (U.S. General Accounting Office, 1978:iii) has independently reached a similar conclusion:

> Although experiments with computerized job matching within the Employment Service have been going on for 10 years, Labor has not demonstrated that this system is an effective way to find jobs for people and people for jobs. . . . Labor's evaluations, past and planned, do not differentiate between improvements due to computerized job matching and those due to other factors, such as changes in the economy or organizational and procedural changes.

We also wish to note, however, that while the evidence is not convincing in the affirmative, neither is it convincingly negative. It is simply not known whether keyword matching produces more and better matches of workers and job openings than manual methods.

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[4] Controlled comparisons of alternative automation systems could provide information in this area. Data from the field studies conducted by the Employment Service, however, are inadequate for these purposes because the field site and type of automation system are entirely confounded (sites had one or the other type of system). No explicit comparative data are presented; the authors of the final report observe (U.S. Department of Labor, 1976a:132):

> Throughout the experimentation, attempts were made to separate out the effects the individual vocabularies [i.e., matching systems] had on the performance data presented in the analysis. This proved most difficult considering the multiple number of variables that may affect the data and especially so in view of the major changes in the economy during the periods covered by the experiments.

It should also be noted that site visits by committee members and staff and statements by state Employment Service officials lead us to suspect that keywording procedures require more personnel time for interviewing of applicants and employers. Keywording also requires the purchase of computer hardware. Since it appears that the capital costs (about $250 million nationwide) involved in keywording may not be offset by decreased labor costs, the lack of convincing evidence that keywording produces more or better placements is disconcerting.

It was neither the intention nor charge of this committee to conduct a field evaluation of the costs and benefits of the keyword matching system. The committee's charge was to assess the need for the *Dictionary of Occupational Titles* and the occupational analysis program of the Employment Service and to suggest avenues for future research, particularly in light of the planned automation of placement services. Upon the subsequent request of the Employment Service the committee agreed to consider briefly the conceptual bases of keyword matching, its potential utility to the Employment Service, and the nature, scope, and appropriateness of various technologies of classification.[5] In this vein we offer three general comments and one particular comment on the manner in which the present keyword matching system operates.

Use of Information

Because machines are (or can be, if properly programmed) more efficient bookkeepers than humans, the automation of local Employment Service offices makes possible new methods of matching workers and jobs that would be completely infeasible otherwise. Many of these opportunities arise because complete information on the work histories, referrals, and placements of workers can be used to guide local offices in deciding which workers make "good" referrals for particular job openings. Similarly, automated procedures could, theoretically, allow for the tailoring of matching strategies to the idiosyncrasies of local labor markets, or they could allow the matching strategies to adapt across time to changes in the functioning of the labor market. Unfortunately, the present keyword system does not exploit these possibilities.

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[5] This committee was not originally charged with evaluating any aspect of the Employment Service automation program. Late in the life of the committee (January 1979) the staff conferred with representatives of the Employment Service and the Employment and Training Administration to discuss the committee's charge and the Employment Service's policy with regard to automation. As a result of these discussions, representatives of the Employment Service asked that some consideration be given to the conceptual bases of keyword matching and its potential utility to the Employment Service in comparison with other possible systems. We were not asked and could not, given the constraints of time and resources, conduct new field experiments to gauge the effects of the introduction of automation in different forms on Employment Service performance. Similarily, we could not design a completely new matching system. Rather, we agreed to raise conceptual questions and consider the nature and scope of appropriate and inappropriate technologies for classification.

To illustrate this point, let us consider how a job-worker matching system might use the information routinely collected by the Employment Service to improve placements and allow for changes across time or differences between labor markets in the types of job-worker matches that are appropriate.

At present, the full histories of workers enrolled at Employment Service offices are obtained by interviewers and coded onto the applicants' records. Indeed, annual national samples of several million of these worker histories are routinely collected by the Employment Service's Automated Reporting System (ESARS) and filed on computer tape in Washington, D.C. Our inquiries, however, indicate that these data are rarely, if ever, used.[6]

How might such data be used to improve job-worker matching? One way would be to build an adaptive matching system that used these data to learn what are "good" and "bad" matches. For example, over a period of time, thousands of secretaries obtain jobs through local Employment Service offices in any given state. There are also some entry-level executives who find jobs through Employment Service offices, and secretaries will sometimes be referred to entry-level executive jobs, albeit with lamentable infrequency. A computerized system that has been programmed to "learn" from its past experience in making referrals could over time recognize patterns of success or failure. The local Employment Service office has information on whether a person whom it referred was hired, and since unemployment insurance claims are also automated, information on how long a worker remained with an employer could also be obtained. Assuming that over time one found that ex-secretaries were hired as entry-level executives and did not appear as claimants under the unemployment insurance (UI) program, a matching system programmed to learn would begin to make more referrals of secretaries to entry-level executive positions. Alternatively, simply analyzing the work histories of Employment Service applicants (without resort to UI records) could provide similar information about the types of "matches" that are possible in a given labor market. In any case, with automated procedures the available job and referral histories could be used to improve job-worker matching.

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[6] The worker history data, taken as nine-digit DOT codes, are keypunched through the first two digits only. This truncation, which could easily be avoided, precludes the use of these valuable data to evaluate the interoccupational mobility of Employment Service registrants. One suspects that if these data were actually used to study Employment Service operations and ways of better matching workers and jobs, the remainder of the DOT code would not have been discarded.

Let us take another example. Consider a hypothetical labor market in which large numbers of engineers are laid off owing to cutbacks in the aerospace industry, while simultaneously, a computer firm opens a research center in the area. Assume that some aerospace engineers also have skills that are attractive to the computer firm, (e.g., in software development, telecommunications, and programming) and are hired for research and sales jobs. Assume also that some of these workers subsequently register with the Employment Service (perhaps seeking work in their former occupation). Their work histories are routinely recorded and coded. An adaptive computerized matching system would note that there were a number of computer-related occupations into which former aerospace engineers had transferred in that labor market. Thus even though most occupational classifications would not consider the occupations very similar, the labor market information routinely gathered by the local Employment Service might reveal that there was enough transferability of skill and knowledge so that some displaced aerospace engineers could find jobs in new occupations in the computer industry and thus were reasonable matches.

Such adaptive matching strategies use capabilities inherent in automation. Such matching strategies are dynamic; they can change over time. They can adapt to idiosyncrasies in local labor markets. They learn from experience. With such systems the labor involved in collecting information on each applicant's skills and qualifications and maintaining administrative records on the "hires" and "non-hires" that result from referrals becomes a resource for learning how to make better placements. This information teaches the system how to serve workers and employers better.

We are, however, describing a rather different system from the current keyword matching system, which has no facility for learning. In this respect it replicates current practices and overlooks the natural advantages of using machines as record-keepers. In a manual search one cannot continually revise matching strategies; the record-keeping and analysis would strain the resources of a staff many times larger than that of the Employment Service. However, machines, when they are properly programmed, are superb cataloguers, recorders, and tabulators of such information. Since all the necessary information for such an adaptive matching system is routinely collected and encoded by the Employment Service computers, no further staff time would be required—just a different computer program.

We suggest that the failure of the keyword system to use administrative records to evaluate and refine its matching strategies is its first and most important conceptual inadequacy.

The Definition of Similarity

In any system of matching, the crucial question is, How similar must two objects be to "match"? This is a basic question of classification. For some things, there appear to be natural categories: plant or animal, female or male, alive or dead. Distinctions such as these are not without anomalies (e.g., euglenae, hermaphrodites, and the brain dead), but they are useful classifications in many spheres of everyday life. In other areas, distinctions may involve questions of degree rather than categorization, such as the difference in rainfall between London and Paris or the difference in speed between a train and a plane. In some situations the similarity between two objects may be imperfect but sufficient for one to treat the objects as being equivalent.

Parallel questions arise in matching occupations. Some occupations are sufficiently similar that a worker in one occupation can be substituted for a worker in the other occupation in most circumstances. For example, for many jobs it is of little importance whether a statistician is an applied statistician or a mathematical statistician. In particular, if one asks only elementary questions about sampling theory or the measurement of association, either will do perfectly well. There are, of course, instances in which greater specificity will be required, for example, a university hiring someone to teach a course in applied statistics.

To judge the similarity between workers and jobs, one must make judgments about the transferability of skills between occupations. It must be decided how similar job requirements and worker attributes must be in order to match. The keyword approach to this problem is simple to state.[7] In the keyword system, jobs and workers are assigned to one of 36 major occupational units; a primary term from that unit describes the major aspect of the work. As noted above, these primary terms consist almost exclusively of occupational titles that have been grammatically transformed, e.g., anthropology work (anthropologist). The similarity between these primary terms is defined only in the special case in which one primary term is a subclass of another. For example, "sociology work" is subdivided into two subclasses: urban sociology work and rural sociology work (a division sociologists will, no doubt, find bizarre). Only in such instances is there a procedure (called tree codes) for matching persons and jobs coded with different primary terms. Thus if the interviewer specifies a special search strategy called "explosion," "rural sociologist" will be considered for job openings coded simply as "sociologist."

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[7] In this discussion we leave aside matching criteria that are not occupational, such as geographic location (see footnote 3).

Because the similarity of primary terms and hence occupations is largely undefined in the keyword system, there is no way to build linkages across work areas. Instead, "complementary" terms describing less central characteristics of occupations are used to accomplish such matching. Let us consider an urban sociologist. One might code experience in "research" (38063) and education plus experience in the study of migrants (52205) as complementary terms. How would this person be matched against a job file containing no openings coded with the primary term "sociology work"?

The similarity between the applicant and job orders is scored by counting the number of complementary keywords that the applicant and order have in common. Since there were no openings for sociologists, it is likely that there would be no order coded with the complementary term for the study of migrants. There would be, however, a number of jobs that would have research (38063) coded as a keyword. These might be in agricultural research, petroleum engineering research, chemical research, etc. Since the keyword system merely counts the incidence of matches on the complementary terms, our urban sociologists would be judged equally similar to jobs involving political science research and geography research (with only a single match—the complementary term research—both jobs will have identical similarity scores).

We suggest that the lack of similarity measures for the primary occupational terms is a fundamental deficiency of keywording. This deficiency affects all occupational areas. Indeed, one suspects that it will be most serious for occupations that do not require extensive credentialing or maintain professional guilds that restrict mobility from one occupation to another.

Adequacy of the Occupational Unit Division

The keyword system divides the occupational world into 36 occupational units. A list of the occupational titles included in each unit is provided in reference notes to the interviewers. More than 600 titles are listed in all. In order to assess the usefulness of the keyword units in matching workers and jobs, we attempted to assign the 441 detailed occupational titles of the

1970 Census to these 36 keyword units.[8] Although the translation of the Census codes into the keyword occupational units is subject to some ambiguity, it did provide a rough guide to the way in which the keyword system divides up the national labor force and to how adequately it groups together occupations between which considerable occupational mobility occurs.

How the keyword system groups together occupations is important because each of the 36 occupational units uses different sets of complementary terms. Matches across different occupational units are less likely than those within the same unit because there is a smaller number of complementary terms in common between units.

Our exploratory analyses indicated that the occupational unit structure of the keyword system did not capture a major portion of the regularity in the naturally occurring patterns of labor mobility. Cross-tabulations of workers' 1965 by 1970 occupations using the 36 keyword units showed less orderliness[9] than similar tabulations using other classifications such as the U.S. Census, the SOC, or the DOT. While the comparison of such statistics for classification having different numbers of categories can be problematic in some cases, in this instance we observed that a highly detailed classification (36 occupational categories) yielded lower Chi-square values than more abbreviated classifications (i.e., U.S. Census: 12 categories; DOT: 9 categories; SOC: 21 categories). In this case[10] it is reasonable to conclude

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[8] We have performed this analysis in two ways: (1) by using the occupational titles listed at the beginning of each keyword unit to assign the census titles to the keyword units and (2) by having two Employment Service staff members (experienced in keywording) assign each census title to a primary keyword unit. Here we report the results from the latter procedure, which provided a more complete accounting of the 441 census occupations. The substantive results derived from the two methods are sufficiently similar that our conclusions would not be altered by using one or the other method.

[9] As measured by the likelihood ratio Chi-square statistic.

[10] The analysis was done using data for workers who (1) had reported occupations in 1965 and 1970 and (2) had changed occupations (as reflected in the detailed census codes). The DOT and SOC major group codes were assigned to a detailed census category using information from a double-coded CPS sample. Each of the 441 census occupations were assigned to the 1 of 9 DOT and 21 SOC major groups into which the majority of workers in this occupation were classified in the double-coded survey. The basic mobility matrix showing occupational transfers between 1965 and 1970 was then reordered by using the major groups of the new classifications. Likelihood ratio Chi-square statistics were computed for the simple independence model (i.e., random transfer between occupational categories) and for several models of quasi-independence (e.g., where the diagonal of the moblity matrix was purged) by using techniques developed by Leo Goodman. For the simple independence models the results were the following:

Continued overleaf

that the 36 keyword occupational units do a relatively poor job of mirroring the naturally occurring patterns of labor mobility. While the crudeness of our techniques requires us to be cautious in interpreting small differences, the results obtained in our exploratory analyses were quite substantial. Comparatively speaking, the keyword occupational units do not adequately group together occupations between which there is a substantial movement of workers.

The shortcomings of the occupational unit arrangement are another serious conceptual problem of the keyword system.

Diversity of Computer Hardware and Languages

A major practical problem of the present keywording system arises from the manner in which the Employment Service has implemented its automation plan. At present, major sections of the keyword system and related aspects of the Employment Service's Automated Report System (ESARS) are programmed in a variety of machine-dependent[11] languages running on computers supplied by four vendors: IBM, Honeywell, Univac, and Burroughs. The states participating in the automated matching system choose their own computer vendors. The decision to use machine-dependent languages (PL-I and assembly languages)[12] rather than machine-independent languages (e.g., COBOL, FORTRAN) was made, in part, because greater efficiency of computer operation could be achieved by tailoring the matching programs so as to take advantage of differences in the architecture of the various computers.

A major advantage of machine-dependent languages is their efficiency. Writing programs in the actual language of the computer (i.e., the machine or assembly language) ordinarily results in considerable efficiencies at execution. The programs take less time to operate, although they take

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Classification	Number of Major Categories	df	Likelihood Ratio Chi-Square
Keyword	36	1,156	148,584
SOC	21	324	311,720
Census, 1970	12	121	283,899
DOT	9	64	189,596

This comparison indicates that despite the large number of degrees of freedom associated with the keyword-classified mobility matrix, it captures less of the orderliness of occupational transfers than classifications using a smaller number of categories.

[11] Machine-dependent and machine-independent refer to the ability of a computer program to run on machines other than that on which it was written, e.g., machines manufactured by other companies. A machine-dependent program cannot be run on a different machine.

[12] Development was initially done on IBM hardware, and substantial parts of the matching system were programmed in PL-I and IBM 360/370 assembly languages. These programming languages are not available on the machines produced by other manufacturers.

longer to write. Programs written in high-level, machine-independent languages must first be translated (i.e., compiled) into machine language before they can be run. The results of such general translations are not usually as efficient as a comparable program for the same task that was originally programmed in machine language.

A major advantage of higher-level languages is their portability. A program written in standard COBOL or FORTRAN can be translated by each manufacturer's hardware, and it will perform identically on IBM, CDC, Honeywell, Burroughs, or other computers. A matching system programmed in a higher-level language could be implemented, without reprogramming, in the 50 states regardless of where the states buy their computers.[13]

The fact that the Employment Service automation plan has used nonstandard hardware and programs written in machine-dependent languages causes delay in the implementation of program changes and uncertainty as to whether the states are operating in the same manner and producing comparable, correct statistics on local operations. Furthermore, the possibility of implementing major changes in the keyword matching system is impeded by the fact that any change would have to be programmed four times—once in IBM assembly language and once in the assembly languages of Univac, Burroughs, and Honeywell.[14]

The use of both nonstandard hardware and machine-dependent computer languages in the design of the automated matching system is a major problem of the current system. It has the important practical consequence of inhibiting attempts to improve the system through redesign.

CONCLUSION

In the foregoing pages we have presented specific criticisms of the Employment Service's automated keyword matching program. The apparent inadequacies and inefficiencies of this system are not trivial, and the thought and effort required to remedy them are likely to be substantial. The foregoing catalogue of criticisms was prepared, however, with limited resources in a relatively short period of time. It would be ill-advised, in our opinion, to attempt to redesign the current system on the basis of this assessment alone.

It would be a wiser investment of resources first to enlist the assistance of a planning group, composed of individuals knowledgeable in the areas of artificial intelligence, the management of complex data bases (e.g., in computerized bibliographic searching), heuristic search techniques and their applications, and other areas of computer science, together with individuals knowledgeable in labor economics, occupational analysis, and the functioning of the Employment Service. This group should be charged with two missions. First, it should be asked to provide advice concerning short-term modifications that could be made to the current automated matching system in order to improve its performance. In this regard, the group could assess system modifications that might be expeditiously designed and incorporated in actual state Employment Service operations in 1–2 years' time. Such short-term enhancements to the keyword system might include (1) installation of supplementary matching strategies, (2) recoding of machine-dependent sections of programs to machine-independent languages in order to ensure standardization of Employment Service operations and statistics and to facilitate updating of the system, (3) improvement of keyword matching strategies, and (4) elimination of operational inefficiencies (e.g., use of ordinary English keywords rather than numerical codes).[15] These initial enhancements could be overseen by the planning committee and implemented by the Employment Service Division of Automated Matching, with assistance from outside contractors if it were appropriate.

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[13] Assuming that the hardware configurations are adequate (e.g., if one needs to read tapes, each machine must have tape drives, etc.).

[14] One Employment Service official knowledgeable in this area estimated that any major change to the architecture of the system would take a minimum of 2 years to program and implement (at current levels of staffing).

The initial stage of work by such a group would attempt to provide useful enhancements to the current system. This, however, should not be the final goal of the group's work. In a second stage of its work, the group would undertake a fundamental reassessment of automated matching. Our limited review suggests that a fundamental reconsideration of the architecture and logic of the keyword matching would be appropriate.

The anticipated costs of the Employment Service's automation plan—currently estimated at $250 million—justify a careful and thoughtful review of the current system. If redesign is warranted and basic changes in the architecture and functioning of the system are contemplated, then sufficient time should be allowed for careful implementation of the new system and detailed evaluation of its impact. If properly planned, phased implementation of a new system could be carried out in such a way as to facilitate careful experimentation to monitor the effectiveness of the new system. This undertaking could also be overseen by an advisory committee expert in relevant areas of science and technology.

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[15] It should be clear that these are merely examples of questions that might be considered. Clearly, the usefulness of such a committee would depend upon its ability to dismiss any or all of these suggestions and to consider an entirely different set of enhancements if that seemed appropriate.

APPENDIX

H

Using Mobility Data to Develop Occupational Classifications: Exploratory Exercises

JOHN A. HARTIGAN

How can occupational mobility data help occupational classification? They may help determine that two occupational titles with slightly different definitions are similar enough to be amalgamated or that some occupation is attracting two distinctly different types of workers and should perhaps be split. They may also supplement the *Dictionary of Occupational Titles* in suggesting plausible cross-listings for job titles. Occupational mobility data can contribute only a little, however, to the definition of occupations in terms of job tasks: for that, occupational analysis or some alternative methodology is needed.

The most significant use of job mobility data is to suggest a suitable hierarchical organization of occupations, given a set of occupational definitions. Mobility data are of value in grouping occupations in a way that reflects the transfer of workers between occupations within a group. Mobility data also are of value in constructing career ladders, that is, hierarchies of occupations up which workers tend to move in the course of successful careers.

We have conducted an exploratory analysis of alternative methods of classifying occupations. This analysis assessed the feasibility of developing classifications consisting of groups of occupations between which there are high rates of labor mobility.

Our basic data consist of the transfers between the 441 U.S. Census occupational categories between 1965 and 1970.[1] Unfortunately, data on various extra-labor-force statuses (e.g., unemployed, in school, in armed forces, etc.) were not available to us. Similarly, no data coded into the 12,099 DOT occupational titles are available, nor are any data available that give complete work histories or short-term transfers between jobs.[2] More appropriate data are needed for future work in this area. We use the available census data for our exploratory purposes to illustrate how one might proceed in constructing a classification based on naturally occurring patterns of labor mobility.

The first problem we faced in this analysis was the storage and manipulation of the full mobility matrix for the 441 detailed census occupations. A 441 × 441 matrix is formidable (194,481 cells), and the 12,099 × 12,099 matrix for the DOT (more than 146 million cells) is even worse to contemplate. A more manageable way to manipulate such data is to represent them in a list structure, which gives for each 1965 occupation a list of 1970 occupations to which transfers took place and the corresponding counts in each of these occupations. The total storage is reduced without much loss by eliminating very small counts. It is also necessary to carry the transposed list ordered by 1970 occupational categories.

STANDARDIZED RATES AND PROBABILITY MODELS

In order to adjust for different numbers of workers in various occupations, Goldhamer (1948) proposed the standardized rate

$$t_{ij} = \frac{n_{ij}N}{n_{i.}n_{.j}} ,$$

where

n_{ij} number transferring from job i in 1965 to job j in 1970;
$n_{i.}$ number in job i in 1965;
$n_{.j}$ number in job j in 1970;
N total number of workers.

Hauser (1978) notes that this measure does not adjust for expected diagonal peculiarities and suggests a measure in which the "margins" $n_{i.}$

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[1] See Sommers and Eck (1978) for a description of the data used in these analyses.

[2] Had the work history data routinely collected from Employment Service job applicants been available for analysis, we could have conducted a much more interesting and informative exercise. Unfortunately, although the work history data are initially coded with nine-digit DOT codes, all but the first two digits are dropped when the data are put on tape.

and $n_{.j}$ ignore specified cells such as the diagonal ones, using Goodman's (1969, 1971) quasi-independence techniques. For example, $n_{i.}$, $n_{.j}$, and N might all plausibly be defined ignoring the diagonals.

For a hierarchical structure on the set of jobs, consider the model

$$p_{ij} = p_{i.} p_{.j} \lambda_{G(i,j)} ,$$

where

p_{ij}	probability of observing a transfer i to j;
$p_{i.}$	probability (roughly) that a worker begins in job i;
$p_{.j}$	probability (roughly) that a worker ends in job j;
$\lambda_{G(i,j)}$	transfer rate corresponding to the smallest group G containing job i and j; there will be a different rate for each group.

Following the standard quasi-independence procedure (Haberman, 1974), the maximum likelihood estimates of $p_{i.}$, $p_{.j}$, λ_G are obtained by setting the observed margins and between-group transfers equal to their expected values under the model

$$n_{i.}/N = p_{i.} \left[\sum_j p_{.j} \lambda_{G(i,j)} \right]$$

$$n_{.j}/N = p_{.j} \left[\sum_j p_{i.} \lambda_{G(i,j)} \right]$$

$$n_G/N = \lambda_G \left[\sum_{G(i,j)=G} p_{i.} p_{.j} \right] .$$

Solutions may be obtained by solving successively for $\{p_{i.}\}$, $\{p_{.j}\}$, $\{\lambda_G\}$ with the other parameters fixed. The overall fit of the model may be measured by the log likelihood

$$L = \sum_{i,j} n_{ij} \log \hat{p}_{ij} .$$

This measure permits comparison of various hierarchies. It also allows construction of new hierarchies by seeking groups G that make L as large as possible. Conceptually, the procedure is straightforward; computationally, it would be quite a chore to design iterative parameter estimates for a list data structure and to improve the hierarchy by moving jobs between groups.

CLUSTERING ANALYSES

Alternative procedures are available. A hierarchical clustering has been carried out by Dauffenbach (1973). He discusses the 1970 Census classification and principles for constructing a new classification. For job *i* a vector is constructed equal to the proportion that transfer from job *j* to job *i* for all *j*. Distance between jobs is the Euclidean distance between these vectors. (Some other distances and data vectors are also considered.) Thus two jobs are similar if there are similar patterns of movement into them. Complete linkage clustering (cf. Hartigan, 1975) was then used to construct a binary tree of clusters on the set of all jobs. The results are not very different from the census classification.

The measure of distance and the data vector of proportional transfers used by Dauffenbach are not wholly adequate. In particular, there will be large transfers from jobs with many workers, and such jobs will tend to make large contributions; there will be many entries near zero in every vector, and it seems wrong to ignore this property of the vectors; the essential information in the data is carried by the transfers from each job to just a few other jobs. The problem with the measure of distance is that after we have computed Euclidean distance between two vectors of length 441, we do not know what we have. Complete linkage is statistically inconsistent. Nevertheless, Dauffenbach's clusters are suggestive.

An alterative method of constructing clusters uses a quasi-independence model (see Appendix G). This would require advanced programming that has not been done. A simpler method is to use the standardized transfer rates

$$t_{ij} = \frac{n_{ij}N}{n_{i.}n_{.j}}$$

where

$n_{i.}$	total number transferring from job *i*;
$n_{.j}$	total number transferring into job *j*;
N	total number of transfers.

Any two jobs *i* and *j* are similar if t_{ij} and t_{ji} are both high; the measure of distance between *i* and *j* is $d_{ij} = 1/\min(t_{ij}, t_{ji})$. The single linkage technique constructs clusters by linking together jobs for which the transfer rate exceeds some threshold; a cluster is made up of jobs linked together. Varying the threshold produces a hierarchy of clusters.

We have applied this technique: the clusters obtained are shown in Table H-1. Like Dauffenbach's clusters they draw together different levels of skills, such as librarian and library attendant or health record technician and medical secretary. They also show some absurd associations, such as dentist and flight engineer, which are due in part to single linkage chaining together a number of slightly related jobs and in part to the unreliability of transfer rates that (because diagonal terms are removed) may be rather high for jobs with high retention rates, from which people transfer to just a few other jobs.

CAREER LADDERS

We would like a classification scheme not only to group together occupations between which transfers are likely but also to order occupations so that transfers tend to take place from lower-ranked jobs to higher-ranked jobs. In order to accommodate both aims and to explain the transfer data succinctly, it would seem desirable to put jobs close together in the structure whenever there are many transfers in either direction. The small groups should therefore consist of families of jobs within which a career ladder exists; there may only be a weak ladder relationship between the larger groups. (In the census scheme there are strong ladder relations between the large groups.)

A probabilistic model constructs an ordering and a hierarchical classification of all jobs. The probability of a transfer *i* to *j* is

$$p_{ij} = p_{i.}p_{.j}\lambda_{ij},$$

where

$p_{i.}$ is the probability (roughly) that a person is in job i in 1965,
$p_{.j}$ is the probability (roughly) that a person is in job j in 1970, and
λ_{ij} is constant over all $i < j$ such that G is the smallest group containing i, j.

To estimate the parameters given the order and hierarchy, it is sufficient to know the marginal numbers of workers, the number of transfers from lower-status to higher-status occupations within each group, and the number of transfers within each group.

TABLE H-1 Single-Linkage Clusters

Occupational Title	Pairs With Transfer Rates Greater Than Expected
1. Computer programmers, system analysts	3, 4
2. Farm management advisor, agricultural scientist, archivist, biological scientist, social scientist, agriculture teacher	17, 27, 23, 29, 61, 64
3. Home management advisors, dietitians	19, 45
4. Judges, lawyers, librarians, law teachers, library attendants	20, 21, 22, 84, 178
5. Actuaries, mathematicians, statisticians	24, 25, 26
6. Chemists, chemistry teachers	30, 67
7. Marine scientists, physicists, physics teachers, engineering teachers, political scientists, psychologists, sociologists, mathematics teachers, psychology teachers, business teachers, economics teachers, history teachers, sociology teachers, social science teachers, foreign language teachers, unspecified university teachers	32, 33, 68, 69, 57, 58, 59, 70, 72, 73, 74, 75, 76, 77, 82, 88
8. Dentists, optometrists, pharmacists, physicians, health teachers, airplane pilots, air traffic controllers, flight engineers, dental lab technicians	38, 39, 40, 41, 71, 103, 104, 106, 229
9. Podiatrist, clinical technicians	42, 48
10. Dental hygienists, health record technicians, medical secretaries	49, 50, 196
11. Theology teachers, clergymen, religious workers, n.e.c.	85, 54, 55
12. Social workers, clerical assistants	62, 168
13. Atmospheric teachers, biology teachers	65, 66
14. Surveyors, chainmen	101, 312
15. Embalmers, funeral directors	105, 130

16. Authors, editors and reporters, radio and television announcers	113, 116, 121
17. Painters and sculptors, sign painters	118, 292
18. Photographers, engravers, photoengravers, pressmen plate, pressmen apprentices	119, 234, 277, 284, 285
19. Sailors (deckhands), boatmen, fishermen, pilots	344, 362, 377, 136
20. Railroad conductors, brakemen, switchmen	141, 369, 370
21. Auto accessory installers, bakers, bookbinders	212, 213, 216
22. Tile setters, floor layers	299, 236
23. Metal heaters, heat treaters, rollers	325, 242, 286
24. Locomotive engineers, locomotive firemen	247, 248
25. Opticians, special craft apprentices	272, 303
26. Painter-apprentices, plumbers (pipe fitters)	274, 281
27. Plasterers, plasterer apprentices	279, 280
28. Sheetmetal workers, sheetmetal apprentices	288, 289
29. Shoe machine operators, shoe repairmen	347, 291
30. Telephone installers, telephone linemen	297, 298
31. Tool and die makers, tool and die apprentices	300, 301
32. Dressmakers, milliners, blasters, and powdermen	316, 331, 310
33. Mine operatives, mine motormen	332, 367
34. Lumbermen, teamsters	382, 384
35. Private cooks, housekeepers, maids	437, 438, 440

NOTE: Single-linkage clusters joining pairs of jobs with mutual transfer rates exceeding 65, the expected number. Numbering is the ordered sequence of 441 jobs in the 1970 Census classification. All other jobs do not associate at this threshold. Christel Mack of Yale University is to be thanked for her work in the preparation of this table.

Sophisticated programming is required to construct a hierarchical clustering and an ordering according to this model.

A quick but less adequate way to construct an ordering is as follows. Let s_i be the level of the *i*th job. Compute $\{s_i\}$ so that most transfers from *i* are to jobs *j*, where $(s_j - s_i)$ is small. The easiest criterion to minimize is the sum of $(s_i - s_j)^2$ over all transfers, subject to the condition that the sum of s_i^2 over all workers be fixed. This criterion leads to the iterative $\hat{s}$ equals the average s_j over all transfers to and from *i*, equal to $\Sigma_j (n_{ij} s_j + n_{ji} s_j)/\Sigma_j(n_{ji} + n_{ij})$ for obtaining improved estimates $\hat{s}_i$ given the old estimates s_i. The starting point for the estimates would be the original numbering for the jobs, which will give a crude rank order by level in the standard classifications. The procedure should be repeated several times.

Another simple procedure is to reorder the jobs so that as many transfers as possible take place to increase the ordering; this is simpler conceptually but more complicated in computation than the procedure described above.

FEASIBILITY

Our analyses were carried out to explore the feasibility of using mobility data to construct an occupational classification. Our tentative conclusions are the following:

1. Mobility data can be useful for constructing a hierarchical classification and ordering of occupations, but the basic occupational titles on which the mobility data are collected must be defined by other procedures.
2. There are formidable statistical and computational problems involved in constructing a classification in this way. In particular, in developing classifications for job-worker matching, it is crucial to pay careful attention to activities before entry and after exit from the work force. In addition, computations should be carried out using list structures; a standard matrix representation is not feasible.
3. Some plausible statistical models for transfers are available and could be used as a guide in evaluating and generating classifications and career-ladder orderings.
4. Crude reclassifications and orderings suggest that the 1970 Census classification had many pairs of similar jobs in quite different groups, owing to its emphasis on socioeconomic status.
5. It would be feasible to construct occupational groupings so that most transfers take place within relatively small groups and so that most transfers take place upon a career ladder.

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